SCIENTIFIC AMERICAN

THE MEANING OF THE BRAIN
By Prof. G. Elliot Smith

MAKE-BELIEVE TELEPATHY
SCIENCE TURNS DETECTIVE

TWO-WHEELED—BUT HAS FOUR

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JANUARY 1927

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The Real Stuff that You Want in Your Car

You want your car to stay like new. You know that everything depends upon design and material—which you can judge largely for yourself! Simply check for Timken Tapered Roller Bearings.

Transmissions, differentials, pinion or worm drives, rear wheels, front wheels, steering pivots and fans are best wear-proofed by means of Timken Bearings. Their taper design and *POSITIVELY ALIGNED ROLLS* are equally effective against shock, speed, thrust, torque and friction.

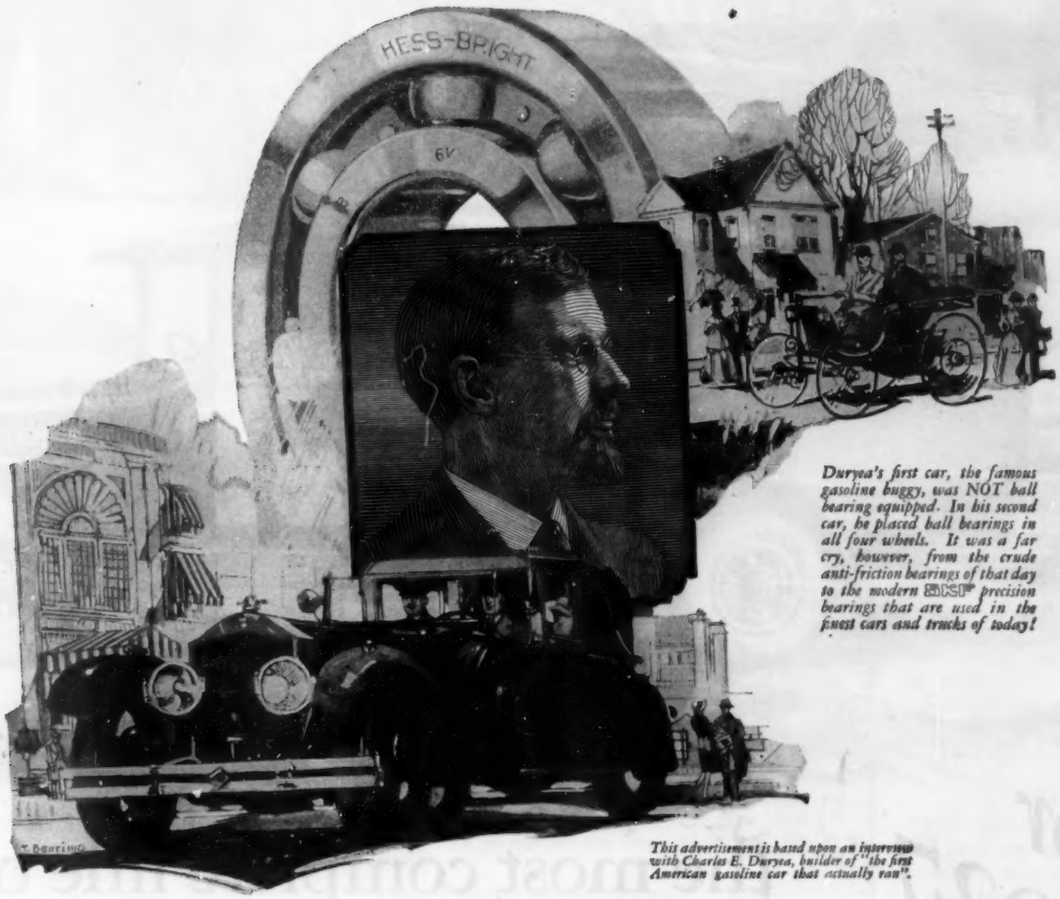
Since it is the bearings which must carry all these forces, the quality of the bearing steel is an important criterion of a car's endurance. Timken steel, made only in Timken electric furnaces, is the kind of material you want at these vital points in your car or truck. You get it in 91% of all American makes.

Timken Bearings are so universally preferred for motor vehicles, and for industrial machinery of every type, that Timken electric steel production is the largest in the world.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

A STEEL WORKER POUNDS RECORDING MARKS INTO BLOOMS OF GLOWING STEEL AND A GREAT CRANE CONVEYS THEM TO THE TIMKEN COOLING PITS



Duryea's first car, the famous gasoline buggy, was NOT ball bearing equipped. In his second car, he placed ball bearings in all four wheels. It was a far cry, however, from the crude anti-friction bearings of that day to the modern SKF precision bearings that are used in the finest cars and trucks of today!

This advertisement is based upon an interview with Charles E. Duryea, builder of "the first American gasoline car that actually ran".

Duryea's First Car Ran on Plain Bearings, But, Even in 1892, His Great Vision Encompassed the SKF-Equipped Car of Today

CHARLES E. DURYEA! His genius produced "the first American gasoline car that actually ran". His cars wrote the opening chapters of automobile history in the dust of American highways. He saw, even in the groping days of 1892, that the automobile, to stand up under the stresses and strains of high-speed driving, MUST be equipped with anti-friction bearings!

Thus, it was natural that, in the DEVELOPMENT of the automobile, SKF Anti-Friction Bearings were destined to play an important part. The modern automobile would be impossible without anti-friction bearings. Anti-friction bearings maintain the alignment of rapidly revolving gears. They insure continuous, smooth and quiet operation. They are essential to comfort and long car life.

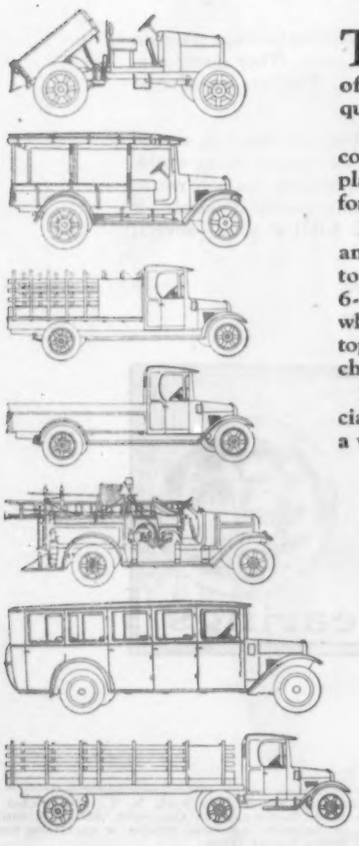
Today, Hess-Bright and Skayef Ball or Roller Bearings, marked SKF, are used on the finest motor vehicles in the world. The symbol SKF on a motor car bearing not only means that it represents the highest bearing quality attainable—it means the RIGHT bearing in the RIGHT place—always!

Remember, when you select or specify anti-friction equipment for ANY purpose, that SKF is the mark of a world-wide organization of men, mines, laboratories and plants devoted to friction reduction through better ball and roller bearings.

1715 ©1927 SKF INDUSTRIES, INC. 165 BROADWAY NEW YORK

THE SCIENTIFIC AMERICAN, January, 1927. Volume 136, Number 1. Published monthly by Scientific American Publishing Company, at 24-26 West 40th Street, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879. Copyright, 1927, by Scientific American Publishing Company. Great Britain rights reserved. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

For 1927 the most complete line of 4 and 6-cylinder Speed Trucks



THE HARVESTER organization announces a complete line of improved Speed Trucks of six distinct chassis designs to meet every requirement for loads up to 1½ tons.

MODEL S is built to carry a 1¼-ton load. It comes equipped with a 4 or 6-cylinder power plant and with any type of body for hauling and delivery.

MODEL SL—safe and low and easy to work with—is a 1½-ton chassis with either a 4 or 6-cylinder engine and has a wheelbase of 160 inches. The top of the frame is only 24 inches from the ground.

MODEL SD is a handy, specially-built 1½-ton chassis with a wheelbase of 110 inches, designed for dump or tractor work. It is ideal for general contracting, road building, and trailer hauling.

Every International Speed Truck is a truck from the ground up—not a rebuilt passenger car. Engine, clutch, transmission, axles, springs, frame, and all the other essentials are the result of 22 years of truck building experience.

Whether your loads run to bulk or weight, whether your business calls for style and distinction or plain utility in its hauling equipment—there is a 4 or 6-cylinder Speed Truck in either a 1¼ or 1½-ton chassis made to meet your needs exactly.

For light, quick hauls we suggest our "Special Delivery," a fast and sturdy model for ¾-ton loads. Any type of body.

The International line also includes Heavy-Duty Trucks up to 5 tons capacity, Motor Coaches, and the McCormick-Deering Industrial Tractor

INTERNATIONAL HARVESTER COMPANY OF AMERICA (INCORPORATED)

606 So. Michigan Ave. Chicago, Ill.

124 Company-owned Branches in the United States

INTERNATIONAL HARVESTER TRUCKS

COMPANY

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, JANUARY, 1927 — *Edited by* ORSON D. MUNN — EIGHTY-THIRD YEAR

FLYING

THE surest way to enlist popular support of aviation and get the public into the habit of traveling by airplane or airship is to prove that air travel can be made as safe as any other form of transportation. As long as people read about this or that skillful flyer being killed, they will hesitate to take to the air. Nevertheless, the Army and the Navy have shown that, with proper inspection, discipline and skill, flying can be made perfectly safe. Thus, the planes of the National Airways maintained by the Army Air Service have flown during the past four years a total of 1,200,000 miles with only one serious accident. Again, a torpedo- and bombing-plane squadron of our Navy has flown 216,000 miles without a single serious accident.

Evidently military flying has been made safe; so may civilian flying; but only by paying the same price of eternal vigilance.

REALIGNMENT

NOWADAYS the times change every ten years or so and those who cannot adapt themselves to the newer conditions fall out of step with life, predict dire disaster, growl and lament; while those who can, live on and realize the most out of passing events. Who would have predicted, a few years past, that by 1926 the railroads would have been heavily involved in motor-bus transportation? Yet a recent nationwide map of bus routes largely operated by the railroads, resembles a railroad map of the country itself, so numerous are the reticulated lines. Significant, also, as an evidence that the railroads see the way the new wind is blowing, are the railroad magazines, *Railway Age* (New York) and *Railway Review* (Chicago). In the former we now find a special department, the "Motor Transport Section." "How to Maintain Motor Buses" is the title of a recent article in the latter.

The world does move on.

ACCURACY

IT is only human that one should prefer the spelling of one's name and the use of the correct titles which association has rendered familiar. So, when others attempt to exercise any option in the matter, a protest is fully in order. May we offer amenity by the corrected statement that D. H. Killeffer, Associate Editor of *Industrial and Engineering Chemistry*, who, by the way, is Secretary of the New York branch, only, of the American Chemical Society, is to contribute a monthly article on the latest advances and developments in the science of chemistry.

In This Issue

Convicted by a Scratch on the Bullet

What is more fascinating reading than a famous murder trial in which the criminal is identified by the marks on the bullet? Such identification combines science and thrills. Turn to page 18 and start reading how a real expert does it.

Your Car in a Test Tube

On an 1,100-acre proving farm with all kinds of roads the General Motors Company is putting autos through more varied and intricate stunts than you could think up in a lifetime. They can tell you before it is delivered to you just how it will stand up under any kind of wear and tear you can give it. See page 22.

What Is the Brain?

Most of us take the brain rather for granted—it is simply a part of our head. To realize, however, the true meaning of the brain and to see what a marvelous instrument it is, read the article commencing on page 13 by Prof. G. Elliot Smith, a noted anatomist. It will make you think.

The Professional Inventor

You probably never heard of William G. Kendall, but the members of your family are helping to pay his royalties. He tells on page 17 just how he rose from a job at $1.50 a week to the point where his inventions are used throughout the civilized world.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 80.

For Next Month

How Coal Is "Liquefied"

For months the papers have been full of mentions about new processes for "liquefying" coal—turning it into gasoline, fuel-oil and other things. Is it feasible? To inform our readers what it really is, and what it is likely to amount to we have obtained a comprehensive article from a leading fuel engineer. Look for the article on this most important subject in next month's issue.

Finding New Elements

Scientists say that there are probably 92 elements. Of these, 90 have now been found. How the search for new elements is made will be explained—and clearly explained—next month by Prof. B. S. Hopkins, the University of Illinois physicist who recently won fame by discovering the element "Illinum."

Beware of "Trick" Diets

Bad news for the overweight: "Any method of fat reduction that professes to avoid dieting or exercise must be a fake." So says a well-known dietetic expert who will write, in the next issue, about the "hows" and "whys" of losing avoirdupois.

Other articles on Bringing the Colorado River to Southern California Cities; The Birthplace of Mankind; Climate; Digging Up Bible Lands; The Stevenson Creek Experimental Dam; Japan's New Cruisers; The Month in Medical Science; The Second of Our Successful Inventors Series; Radio; Astronomy.

MORE THAN 200 PICTURES

¶ **There is one best way to keep in touch with the leaders in the world's progress—by consistently reading the Scientific American.**

$4.00 brings the Scientific American to you for one whole year.

RELICS

ONCE we were laughed at for predicting that electric household refrigerators would soon be as common as "flivvers."

That was five years ago.

Since then, up to 1925, we learn, there has been an average annual increase of 100 percent in the number of installations.

Nineteen twenty-five showed an increase over 1924 of 350 percent!

What will 1926 show?

What will 1930 show?

Imaginary conversation in 1977—*Grandpa:* "When I was a young man they actually brought ice into people's houses to keep their food cool."

Laughter.

"Grandpa, wasn't that in the days of the candle?"

Refrigeration with ice is as wasteful and unscientific as heating with fireplaces.

SHANNON

WHERE the River Shannon flows they are about to erect a huge power plant so that the current of the stream famed in ballad may supply electric current to the entire Irish Free State. It is proposed to use approximately 100 feet of the fall from Lough Derg to the sea by diverting the water from the river ten miles above Limerick and conveying it through a head race canal, one and a half miles long, across the country to Ardnacrusha, the site of the power house.

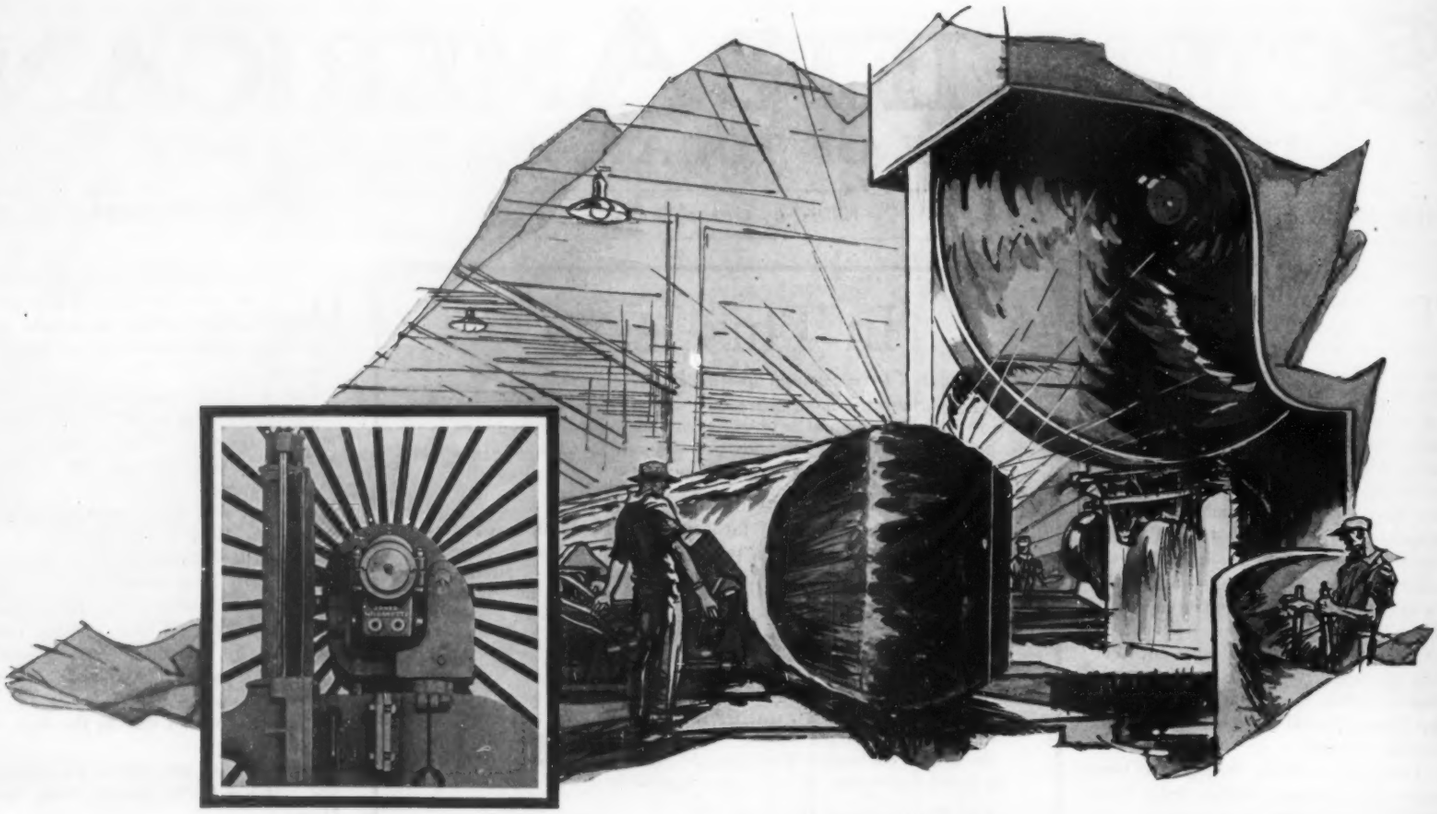
Construction will take about three and a half years and will cost about £5,200,000. It will have an initial capacity of 90,000 horsepower and later an installation capacity of 180,000 horsepower. A contract for the work has been signed with a well-known German firm.

SUPERSTITION

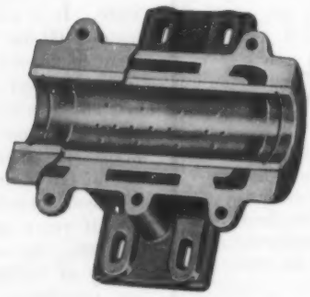
THE following quotation from the *Savannah Reporter* is too good to keep. If you feel yourself going mad, remember the Nelson Madstone.

"Mr. and Mrs. Malcom Russell Smith of Tarkio brought their five-year-old son to the Nelson Madstone, Friday. The boy had been bitten while in the yard by a mad cat. The boy's pet English bull dog came to his rescue and killed the cat or the accident might have been more serious. The stone adhered four hours. The Nelson Madstone has been doing duty in Savannah since 1834 and during the last thirty years Mrs. Armede Humbar has had charge of it. She reports that 2,000 have visited this stone during these 78 years."

This is the age of science, yet many people are still living in the Dark Ages.



Jones-Willamette vacuum oil circulation
—*the solution for your bearing problems*



OIL TIGHT
LESS FRICTION
LASTS LONGER

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing completely oil sealed—oil cannot escape nor water enter.

Built right into every Jones-Willamette bearing is a unique individual oil circulation system.

The rotation of the shaft itself operates the system at all speeds—the entire bearing surface, and particularly the points of greatest friction, are constantly flooded with a film of fresh oil. No matter how high the speed or how heavy the duty, Jones-Willamette Bearings run cool, with friction cut to a minimum.

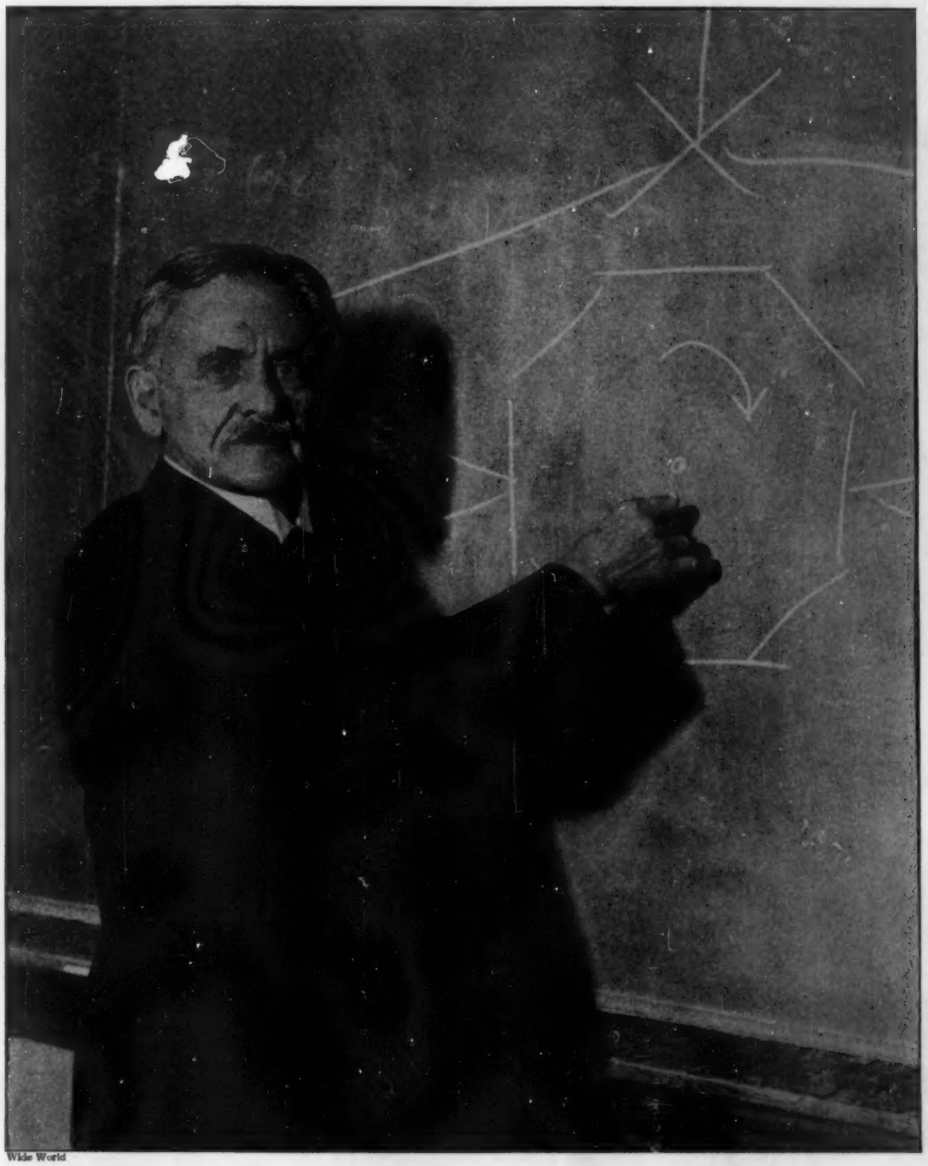
Furthermore, since no oil can leak out of these bearings, they consume a mere fraction of the oil ordinarily required at the same bearing points. This saving and the saving of damage due to oil leakage are very substantial ones, making change-overs to Jones-Willamette Bearings pay immediate dividends.

Jones-Willamette vacuum-circulation bearings are now available in standard and special types to fit the requirements of every industry. If you are a user of bearings you should inform yourself regarding this development. One or two Jones-Willamette Bearings installed in your plant will give you a new idea of bearing efficiency . . . Write for engineering data and descriptive literature.

Willamette Iron & Steel Works, Portland, Oregon

Monadnock Building, San Francisco — L. C. Smith Building, Seattle

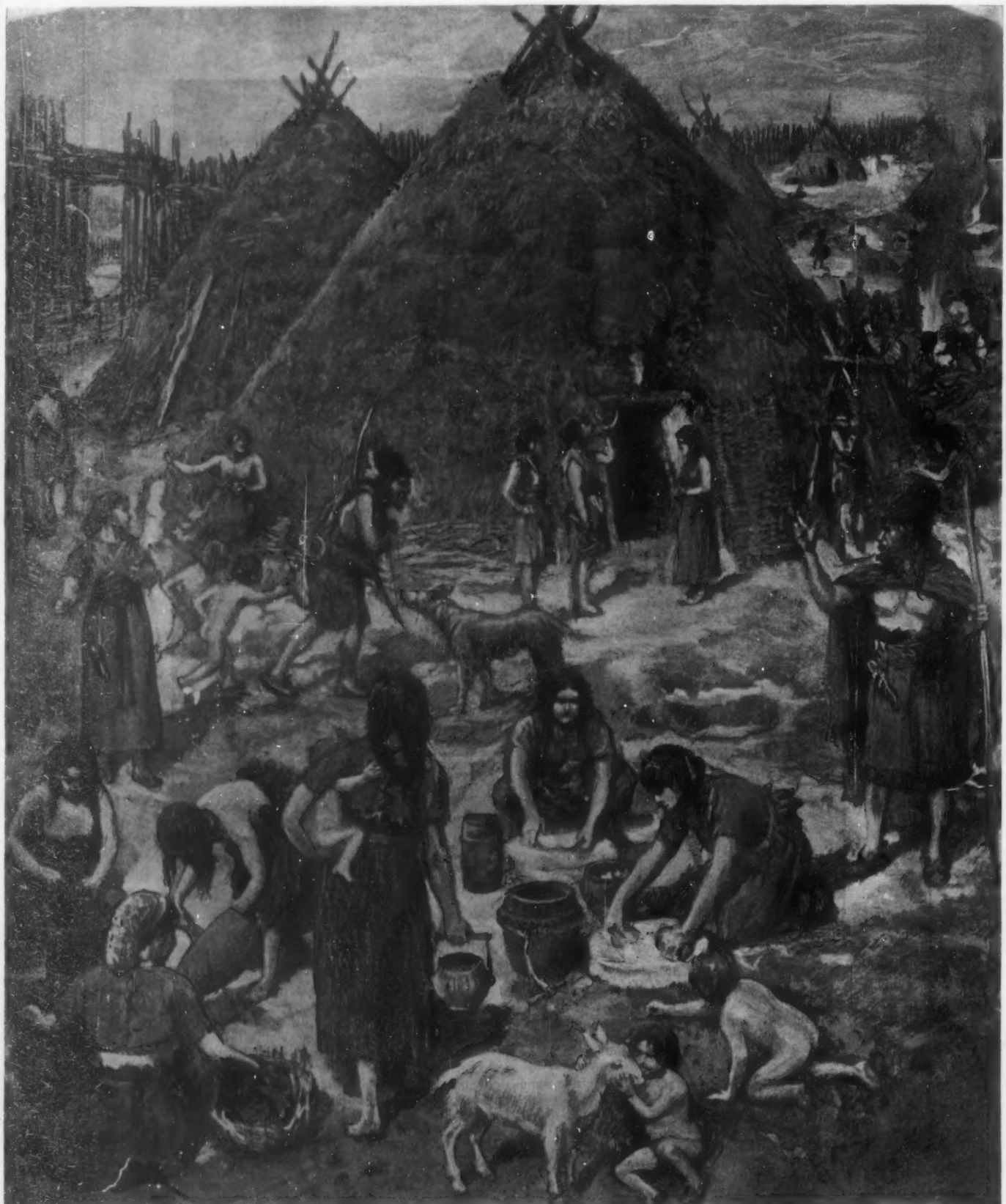
[Jones] Willamette
VACUUM CIRCULATION
Bearings



Wide World

Professor Albert A. Michelson, America's Foremost Physicist

As related in some detail by Prof. Henry Norris Russell in the October issue of the Scientific American, Professor Michelson has completed his latest and most accurate determination of the velocity of light. He now finds that light travels at the rate of 186,173 miles per second. This is about forty miles slower than the velocity announced by him in 1878. The difference represents the result of refinement in the experiment rather than any known or likely change in the velocity of light. By common consensus among scientists Professor Michelson, now in his seventy-fifth year, is the dean of American physicists and the greatest authority on optics in the world. Indeed, one well-known physicist to whom we submitted our belief replied, "Yes, he is. But that is hardly strong enough—better include Mars and the rest of the Universe: nobody knows optics as well as Michelson does." Professor Michelson is President of the famed National Academy of Sciences, a body of less than 300 members deliberately selected from all branches of science, because of past accomplishments and merited eminence. Born in Germany, Professor Michelson came early to America, graduated in 1873 from the United States Naval Academy, and in 1892 was made head of the Department of Physics at the University of Chicago. In 1907 he won the Nobel Prize for Physics.



Courtesy of the "Illustrated London News." From a reconstruction drawing by A. Forestier

A Bronze-age Farming Village in England

From recent excavations in the county of Sussex it has proved possible to reconstruct with striking accuracy the ordinary village life in Britain, 3,000 years ago. According to a writer in the *Illustrated London News* the sites of seven circular huts were laid bare. Woven withes, once plastered with mortar, and evidences of the framework of conical huts, show that even then these prehistoric British farmers lived in relative comfort.

Painted for the Scientific American by Cornelius Hicks

Children of the Sun

For Heat, Light, Energy, Food, Materials and Our Very Bodies We Are Indebted to the Nearest Star—the Sun

*By Paul R. Heyl**

Physicist, United States Bureau of Standards

THE first flush of dawn was in the sky. A California-bound motor, carrying a man and a woman, was crossing Arizona. A little distance ahead of the car was an Indian adobe hut.

"Look!" said the woman. "There—on the roof!"

Her husband glanced up as they approached. Seated on the roof of the hut was a figure wrapped in a blanket, with only the face showing, gazing steadily toward the east, as silent and motionless as only an Indian can be.

"What do you suppose he was doing up there?" asked the woman after they had passed.

"Watching for the sunrise, probably," replied her husband. "I have heard that the Indians in these parts are sun-worshippers. It is curious how extremes meet sometimes," he went on after a pause, for according to his lights he was something of a philosopher. "At Flagstaff (that's the next town ahead) there's an astronomical observatory. Think of that—almost in sight of this heathen nonsense! I'll bet that if that fellow back there knew only one-thousandth as much about the sun as the astronomers do, he would not be acting foolishly on his roof at this hour in the morning."

Truly, extremes meet, and are often correlated closely; for the mental attitudes of the man of science and of the untutored Indian have in this respect much more in common than our philosopher at the steering wheel suspected. Had he himself known just a little more, his regard for the actions of the Indian would have altered from contempt to something very like sympathy. The primitive man in the blanket knew this much: that his very existence depended upon the sun. To him the sun was a beneficent deity that ripened his crop of corn in order that he and his family might eat and live, and to the sun in return he paid his devotion. The civilized man in the motor was probably unaware of the extent of his own indebtedness to the sun's bounty, which, because of his own more complicated life and activity, was proportionately greater than the debt of the Indian.

Coal Is "Canned" Sunshine

All living creatures must have food, and perhaps the most important and fundamental of food-substances is starch. Sometimes we eat it directly, as in bread and vegetables; sometimes indirectly, as when we eat the flesh of herbivorous animals. Starch feeds us all, animals and plants alike, with this important distinction: plants are provided with a laboratory in which they manufacture their own starch-food from its elements, carbon and water, while animals cannot do this, but must depend, directly or indirectly, upon the services of plants for this purpose.

Plants manufacture their starch from the carbon dioxide which forms a small fraction of 1 percent of the air. The leaf of the plant is the laboratory in which this takes place. Here, in some way which is not yet well understood, in the persuasive presence of that curious green compound called chlorophyll, the carbon is induced to part with the oxygen with which it was combined, and to combine instead with water. But so strong is the attachment of carbon for oxygen that mere persuasion will not suffice to separate them. Energy is needed as well, and this is supplied by the light and heat of the sun.

It is of interest to note that the energy of the sunlight alone would not ordinarily be enough to effect this decomposition, else carbon dioxide could not exist in the atmosphere; but, as often happens in human affairs, persuasion backed up by force secures the desired result.

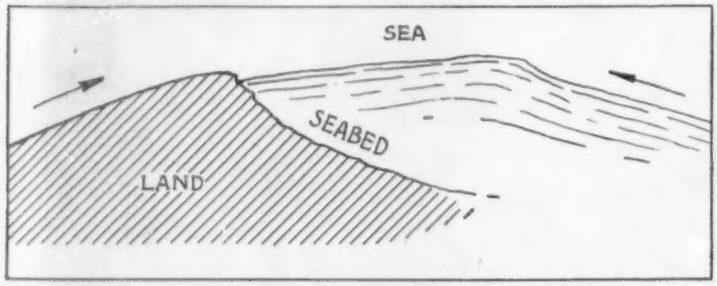
The starch thus synthesized is used, after some further modification, in the formation of vegetable fibre, perhaps the woody trunk of a tree, which later may be cut down and burned in a fireplace. Here in the process of combustion the carbon reunites with oxygen, perhaps (who knows?) with the very molecules from which it was formerly separated.

* Published by Permission of the Director of the National Bureau of Standards of the United States Department of Commerce.

In this act of reunion it gives up again the heat and light energy which it had formerly taken in as the price of parting with its oxygen.

Many weeks or months of sunshine may be required to produce the starch for a single stick of firewood, which may liberate all this energy in concentrated form in half an hour, with the production of a temperature much higher than that of any summer's day.

The heat of a coal fire is of the same solar origin, but farther removed. The plants and trees of the Carboniferous period synthesized their starch and formed their substance just as do their modern descendents; but in the millions of years that have since elapsed, their material has passed through the stages of peat and lignite, and has become coal.



THE SEA-BED BRAKE

LEFT: *In shallow seas the tidal friction is far greater than in open oceans. The Behring Sea alone contributes much more toward the tidal retardation of the earth than all other shallow seas taken together*

The light and heat liberated in burning coal represent so much Carboniferous sunshine, preserved for ages to be set free for our benefit.

The heat of combustion of oils and gasoline has a similar pedigree. The details of the formation of our oil deposits are not yet clear, but whether they were formed by the action of underground heat on coal deposits, as was once supposed (whence the old term "coal oil"), or whether (as is the more modern idea) they are rather to be regarded as fish oil, makes no difference. Whether derived directly from vegetable tissue or indirectly through the intermediate stage of fish, the carbon of the oil may be traced back to the same origin. The energy of the burning gasoline which propelled our motor pilgrims through Arizona was at one time solar heat; but did they cast so much as a glance of thanks backward when the sun rose on that morning? I trow not.

The Sun Restores Humpty Dumpty

The more closely we examine the various manifestations of energy which contribute to our life on this earth, the more difficult it is to find any form of energy which cannot be traced back to the sun. For centuries before the invention of the steam engine, all sea-borne traffic was propelled by sun-power, for the winds originate when one part of the earth becomes more intensely heated than others. The heated air of this region expands and becomes specifically lighter, and is forced up by the cooler and denser air surrounding it, which rushes in currents that we call winds toward the more intensely heated region. Sometimes, as in the case of hurricanes, the bounty of the sun is entirely too liberal, and like the fabled miser of old we are overwhelmed by the golden flood.

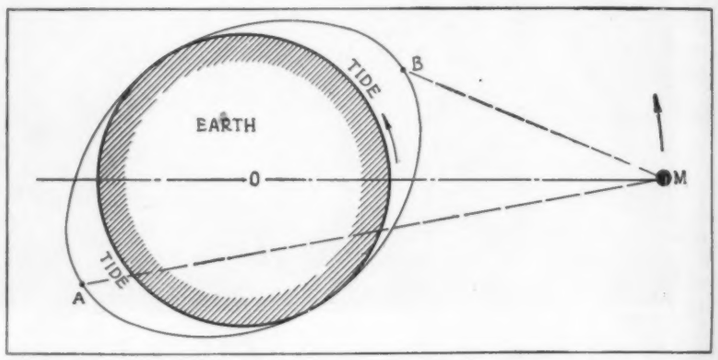
Far-seeing men everywhere are looking to the development of water power as a substitute for coal; but this, too, is solar energy. Water which falls from a height must be replaced if the power is to continue available, and many foot-pounds of work must be expended to put it back again. This is done for us by the sun, who expends his heat lavishly on the surface of the oceans, lakes and rivers, evaporating hundreds of tons of water daily. This enters the atmosphere as vapor, and is raised by wind power (which as we have seen is sun power) to fall again as rain on the uplands.

* Russell: Scientific American, October, 1922, page 268.

It has often been proposed to utilize the energy of the tides. The pedigree of this source of energy is of especial interest, for it comes to us from the sun by some other means that that of light and radiant heat.

The tidal wave caused by the attraction of the moon for the water of the ocean under it, tends to keep its place always beneath the moon, and consequently to pass round the earth as the moon does. Were the period of rotation of the earth a lunar month of 28 days instead of a single day, the earth would always present the same face to the moon, and the tidal wave would remain fixed in the same place on the earth's surface. There would be no rising and falling of the tide to be utilized.

In the passage of the tides round the earth they



TIDAL RETARDATION

RIGHT: *Sea-bed friction retards the tidal bulges so that they lag behind the earth-moon line* MO. *Bulge* B *being nearer the moon than bulge* A, *and angle* BMO *being greater than* AMO, *a retarding force is set up which is very gradually slowing the earth*

encounter resistance when they meet coast lines, which retards very slightly the velocity of the earth's rotation. If in addition the tides encounter any machine set up for the purpose of abstracting any of their energy of motion the drain on the earth's store of rotational energy will be still further increased. Any work gained from the tides is therefore drawn from the energy of rotation of the earth.

Is the earth's rotation to be traced back to the sun? Undoubtedly. The old nebular theory of the origin of the solar system has been rather discredited of late, and the present belief is that our solar system originated by the chance passage of another star near enough to our sun to raise great tides in his body—enormous outstretched arms like those solar prominences which can be seen at times of an eclipse. It is believed that under the attraction of the visiting sun, considerable portions of our sun's body were detached, later to assume the form of our planetary system.* The spin of the earth doubtless originated at the moment of separation from the sun, perhaps by a "crack of the whip" when the sun let go.

The internal heat of the earth is another possible source of energy which of late years has actually been drawn upon. In certain districts of Italy and in Sonoma County, California, jets of steam issue continually from crevices running deep into the earth. This steam is collected and used to operate steam boilers. It cannot be directly used in an engine, as it contains corrosive materials.

The internal heat of the earth may in part be a remnant of the heat which it carried away on its separation from the sun; but modern thought inclines to the opinion that this constitutes but a minor fraction of the heat now in the earth, the remainder being due principally to the slow decomposition of radioactive material in the rocks of the earth's crust. Such a source of energy may, in a sense, be considered as extra-solar, though of course all such material, with its possibilities of generating energy, came originally from the sun.

UTILIZING VOLCANIC STEAM

In Sonoma County, California, a number of natural steam vents have been put to work generating electricity

About the only source of energy which we can definitely attribute to some other source than our sun is the small amount of light and heat that reaches us from the fixed stars. The moon and the planets shine by reflected light of the sun, but the stars are self-luminous bodies.

When we consider how large a part is played by the use of fuel in our modern civilization, in metallurgy and manufacture, in lighting and transportation, in fact, in everything that distinguishes the life of man from that of the beasts; and when we recognize that all substitutes for fuel that are available to us derive their energy likewise from the sun, we may begin to realize the extent of our indebtedness to the sun's bounty. Yet this is not all; for every breath we draw, every movement we make, aye, every thought that passes through our minds involves the combustion of a certain amount of fuel in the bodily system. Each one of us is a complicated heat engine, and the energy of the fuel supply comes, as we have seen, originally from the sun.

When one visualizes the full perspective which such considerations open out before the view, the Indian sun-worshipper ceases to be an object of contempt, and rather commands our sympathy; for naive and childlike as may be his mode of expression, he has grasped, so far as his limited vision permits, one of the grandest concepts of modern science, one of which many men of a higher grade of civilization seem to be totally ignorant. Truly we are in a very real sense all Children of the Sun, of the blood royal.

The Romantic Search for "Pocket" Planets

By Modern "Mass-product" Methods the Astronomer Now Seeks for New Asteroids

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

WHILE the more picturesque discoveries in science win wide recognition, many faithful workers are plodding away steadily at tasks which are less spectacular, although none the less valuable to science as a whole.

Even the professional astronomer often hardly realizes what an enormous amount of labor has been expended by his compeers in some other department of the science. The results of these researches are published here and there in separate articles, often crammed with numerical material—great pages of figures, which only the specialist attempts to read—and it is not until some one collects the scattered publications into a conveniently available summary that the full magnitude of the work can be sensed.

A good instance of this is found in an unpretentious little paper-covered volume which has recently reached this country from Germany—one of the publications of the "Reclam-Institute" at Berlin, the Institute for Astronomical Calculations, which undertakes the heavy task of keeping track of the asteroids. This volume does not pretend to tell astronomers all that is known about this horde of small planets; it attempts only to give those who are working on the subject a "finding list" which will enable them to go to the original sources of publication, where the detailed accounts of the observations and calculations are given, and look the matter up for themselves. Even so, it takes more than a hundred closely printed pages to give the barest summary of the information that is now available.

Old Methods and New

First comes a list of the discoveries of these small planets, in chronological order, running back to the original discovery of Ceres by Piazzi, on the first day of the Seventeenth Century. Like the earlier discovery of Uranus, this first discovery of an asteroid was a happy accident. Piazzi was making a catalog of stars, and found that one of the objects he had observed was moving in the heavens, and was really a faint planet. Three other asteroids, Pallas, Juno and Vesta, were discovered within the next seven years. Then for almost forty years, no more were found—astronomers were not looking for faint enough stars. But one was found in 1845, then in 1847, and not a year has gone by since without its quota.

At first these diminutive planets had to be picked out by the very laborious process of charting the stars in a given part of the sky by measures made at the telescope, and then going over the region again and again, scrutinizing every star, and looking for interlopers.

The fact that between 1847 and 1891, 300 asteroids were discovered in this time-consuming way, shows how assiduous and patient the observers must have been. At about the last-named date, a new and far easier method of search was introduced by Max Wolf, at Heidelberg. He photographed his star fields, instead of observing them visually, "guiding" carefully, so that on his negative the stars appeared as fine black dots. If a minor planet was in the field, its slow but steady motion would draw out its image into a short streak, or trail. An exposure of two or three hours made this trail long enough to be easily detected, and so a planet could be picked out at a glance among the myriad of stars in the field.

This new method was widely accepted, and it has proved so powerful that, in the thirty-five years since it was first employed, more than 1,800 planets have been discovered, and there are evidently still a great many more to be found.

Most of the nearer ones are very faint, of the 13th or 14th magnitude, and their images on the plates are very feeble. It is evidently wasteful to spread out the light of such a faint object into a trail, nor is it necessary, for various observers, notably the Reverend J. H. Metcalf, an American amateur astronomer of distinction, have adopted the scheme of moving the telescope or the plate in such a way as to compensate for the probable motion of the asteroid. The star images in which we are not interested are then drawn out into trails while that of the planet which we desire to observe is concentrated into a dot. Of course, it is not possible to predict the exact rate of motion of an undiscovered planet; but if the adjustment is made for the average motion, it will be clearly enough right for the individual case to diminish the length of the trail greatly and save much light.

Yerkes Observatory

JUST A SMALL PATCH OF THE HEAVENS

Formerly the asteroid seeker had to check up each star individually—like hunting a needle in a haystack

The chief remaining difficulty is to make sure that what looks like the image of a faint planet may be but a mere speck on the plate. Wolf surmounts this trouble by having a pair of cameras, portable, mounted side by side, so that all plates are taken in duplicate, and real and spurious images may be immediately distinguished by comparison of the two.

The discovery of a planet, of course, only begins the work. We must find its orbit; and to do this, even roughly, we require three observations of its exact place in the sky at intervals of a few weeks. The discoverer therefore takes pains to follow up his asteroids until satisfactory observations have been secured. But, too often, cloudy weather or a spell of full moonlight—which fogs the plates—intervenes; and, afterwards, the tiny planet cannot be found. It is "lost" before its orbit can be calculated.

The statistics up to April of the present year show 1,046 planets for which the orbits had been found, and no less than 1,155 others which escaped without sufficient observation to make this possible. It is certain that the 1,046 planets are all different—no two of their orbits are alike; but, among the 1,155, it is probable that the same planet has twice been caught, and twice let slip. Whenever, indeed, a good new orbit is computed, reckoning backward is made and very often it is found that it has been photographed before, but only once or twice, so that the orbit could not be calculated.

When a preliminary orbit has been computed, the place where the asteroid can be found in the following year can be predicted—usually not exactly, but closely enough to get it on new photographs. The second year's observations give a much more accurate knowledge of the orbit, and when the planet has been observed in four or more different years, the resulting orbit may be regarded as thoroughly reliable. Often, however, a planet is missed at the second try, and gets "lost." There are several cases where such lost planets have been rediscovered independently many years later. New calculations showed that they were moving in the old track, and a little more computation proved the identity.

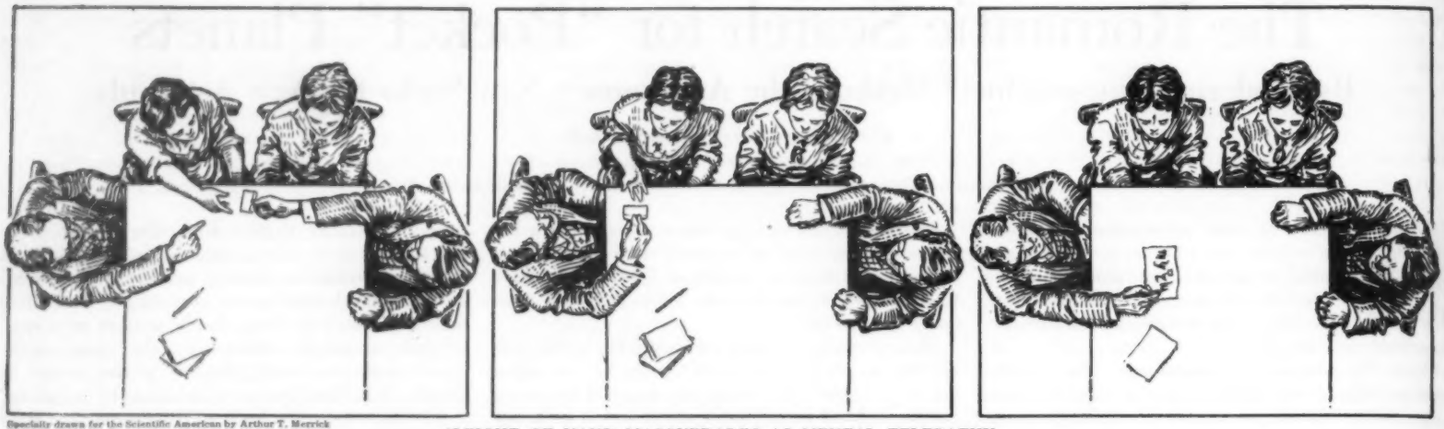
A Week of Calculation

"A little more computation," however, would be a phrase used only by the skilled and experienced calculator. The computation of even a preliminary orbit is a heavy job indeed for the student who tries it for the first time—he may spend a week or more of steady effort before he gets through. The practised hand may do it in two days—but to tie up with later observations in following years takes longer.

Exact calculations, indeed, are appallingly laborious, for the attractions of Jupiter and Saturn are continually pulling the asteroids out of the tracks which they would otherwise follow. We know just how to calculate and allow for these "perturbations," as accurately we choose; but the numerical work is extremely long and tedious, and great care must be taken to avoid numerical errors.

To obtain completely accurate tables for the calculation of the motions of all the asteroids would therefore demand twenty or more years' time on the part of a thousand skilled experts—an impossible demand in the present state of science. Fortunately, rougher formulæ, which makes it possible to follow the asteroid's motion closely enough to be sure of keeping track of it, demand only a few months' work in any given case, and in some instances less. For a few dozen of the thousand, such tables have been calculated—the rest of the work remains for future mathematicians and astronomers.

More might be told of this if time and space allowed; but the little that has been said may show what an enormous amount of work has been done, even in this one small corner of astronomy, and what a vaster amount remains still to do.



Specially drawn for the Scientific American by Arthur T. Merrick

SLEIGHT OF HAND MASQUERADES AS MENTAL TELEPATHY

LEFT: *The "mind reader" points to the lady's hand which is about to receive the slip.* CENTER: *He next hands the slip, held in his finger tips, to the lady.* RIGHT: *He writes the hieroglyphics in order to divert the observers' attention. But see what he has in his left hand!*

Make-believe Telepathy

By Walter Franklin Prince

Research Officer, Boston Society of Psychical Research

WITH those rare persons who seem to demonstrate the possession of supernormal mental powers, such as telepathy, nothing is better established than that the threshold of such powers rises and falls, or in other words, the faucet is not always open widely or at all. Now they can, and again and most frequently, they cannot. Passivity, a quiet mind, freedom from strain, seem most necessary.

Contrasted with these are the glibness and almost unerring success of platform "telepathy," and the impossibility, in the glare of the footlights, of preserving the mental state supposed to be propitious. Accordingly, I think that it may safely be set down that no exhibition of this sort on the public stage, approximately inerrant, is ever a supernormal one. At least, there are so many persons able, by so many artful systems, to confound the public, that any exception to the rule must demonstrate itself by submission to scientific tests. I propose briefly to discuss the work of several more or less noted exponents of trick mind reading, belonging to our own period.

A Matter of Mental Suggestion

Burt Reese, now well above 80 years old, has crossed the Atlantic, he claims, more than 50 times, has astounded royalties, which is not necessarily difficult, and confounded certain men of science here and abroad, which is supposed to be more difficult. Hundreds of people declare that he tells what is written inside folded slips of paper, without touching them. He does not care where they prefer the telepathic or the spiritistic solution. One day he gave me an exhibition in my own offices. He tore a sheet of paper into quadrangular pieces, gave me five and asked me to write questions addressed to dead people. (Later I pieced these together and found that one was missing. This he secretly folded like mine and used as his "dummy.")

While I was writing he selected a flat-topped desk in the next room. (My roll-top desk would have put me on the same side with him.) He suggested that two ladies in the office should participate. Then he inquired searchingly if I knew on which folded slips I had written the questions, respectively, which I did not. (It would be inconvenient to have it discovered that he apparently got back a particular slip from a person to whom I had not given it.)

The ladies sat at the table end, and Reese on the side opposite me. "Give one to this lady," he said, pointing to the one next me. His finger continued to point, his hand near the lady's, as I passed over the folded billet. He had not touched it, yet at the same time had begun to accustom us to his outstretched hand. A first impression was made. "Give one to *this* lady," indicating the one next to him, and again pointing the finger. The impression of pointing but not touching was now deepened, and still more when the action was repeated as the first lady received another billet at his direction. "Keep the other two yourself." The impression was now figuratively written in italics. In the midst of chat he carelessly said, however, "No, I guess we will let this lady have another," pointing to the one next him. I passed the fourth slip over and in the most casual fashion he took it with his hand, but six or eight inches from the lady's hand, and completed the journey to her. Now everything was set and it is here that nearly every sitter thinks that the real business begins. In consequence of the mental picture made thrice by Reese's hand near and pointing but not touching the billet, the variation at the fourth pass is not observed at all or is quite forgotten by almost everyone, so that they afterwards affirm, "He never touched one of them before he told what was on it." But the most important act of the drama has already taken place, for, in the passage of those few inches, he "switched" the billet for his dummy, and the lady received the latter.

Now he wrote hieroglyphics on a sheet of paper with his right hand while his left was under the ledge of the table. This was to enchain the attention of the onlookers who supposed that he would give the sentence by translating his marks, while he unfolded and read the billet and folded it again. After a little stage business he told the contents of the billet and made an appropriate reply. Then he again extended his hand to the lady next him, saying "Give me *that* paper," pointing not to the dummy but the other one. He took it and apparently spread it out on the table, and sure enough, he had correctly given what was written. But he had really switched the one he had just received for the one read and had another ahead. A different "business" was now used to enchain attention as he slyly read the second billet. So through the list, finally going back to the lady who had the dummy and pretending to read that one, although it was really switched and in his safe keeping. This, allowing for variations, is the process by which this man has fooled thousands of business men, lawyers, ministers, college professors, et cetera. It is a marvelous feat, in which probably no other man living equals him. But it is not telepathy.

There Is Always Some Code Used

Multitudes of excellent people, who would not pay attention to the most carefully tested evidence of psychic research, are convinced when they hear a woman on the platform describe objects shown her associate walking about in the audience, give even the numbers on watches, or the names of strangers. Yet there is always some code of signals by which the lady on the platform is informed by her associate in the audience, who knows the facts. Usually it is a word-code. The subtlest changes in the mode of his questions—and there may be many scores of such alterations and the questions still sound substantially the same—have their definite meanings. Sometimes it is a movement code; names, figures, descriptions are telegraphed by gestures and postures of the "agent" or confederate, all so natural and easy that few ever suspect them.

There is a fairly well-working code depending on the speech-tempo of the man on the floor, and the length of pauses between words and sentences. Telegraphic signaling is possible, but it requires the agent to be continually returning to one or two spots where his foot may press a concealed button, and this method is probably never now used. There

A Clear Distinction

Whether certain persons can read minds is not the question raised in the accompanying article. What the author demonstrates is that *most* of those who claim to read minds professionally are not mind readers. In another article he promises he will take up cases in which genuine telepathy is strongly indicated.

When you attend a show in which an "Indian princess" on the stage reads the minds of persons in the audience, how do you react to this performance? Dr. Prince tells you here how your mind is "read." ***—The Editor.***

is even a code based upon eye-movements. And there is a system by which the lady on the platform, with a bandage over her eyes, sits with her back to the audience, and the "agent" puts his questions with no significant variations either as to words or time-spacing. Neither is there any mechanical device employed and yet it is a signal code. I will give a broad hint and the reader may work it out. The figured curtain which the lady faces at the back of the stage is opaque to the audience but can be seen through by the lady near it or a person close behind it.

Probably no inventor of a "mind-reading" system has ever been more successful than Julius Zancig. His mystery held the Alhambra Theatre in London, for instance, 37 weeks. His trophies include most of the crowned heads of Europe and four presidents. Certain noted men, whom I will not name, were convinced. Some clergymen, however prejudiced against any possible evidence for their doctrines of soul survival, were as willing to testify that here was certainly a demonstration of mind-reading as was the great Rev. Joseph Cook to declare the "spirit" slate-writer Watkins beyond suspicion.

When a Fakir Failed

Some who read this will still declare that what they have seen the Zancig pair do could not be explained by any code. But it might strike them as singular that the second Madam Zancig should happen to have the same marvelous power as the first Madam Zancig: to say nothing of the boy who came between. And I assure them that, although I am not at liberty to divulge it, the system (except for one or two special stunts) is known to me. Nor do I think that my friend Zancig has ever expressly claimed that the act was genuine telepathy, although he employs the ambiguous terms common to magicians. There were plenty to proclaim it for him.

Another type of so-called mind-reading is really muscle-reading. The idea is that a person shall think of something that the performer is to do; for example, to find a hidden object. The actual principle is that so long as this person is either in direct bodily contact with the "mind-reader," as by clasping his wrist, or in indirect contact, as by the two holding the opposite ends of a cane, the former unconsciously guides, yielding when the latter goes in the right direction and offering slight but perceptible resistance when he goes wrong.

When I was editor of a magazine an account was sent from Warsaw about the wonderful telepathy of Rom Romano. It was so suggestive of muscle-reading that I would not print it, but my successor did. On the arrival of Romano in New York his manager asked me to test him. I invited a number of persons, including doctors, to be present, and instructed them beforehand how to keep their muscles limp. The result was that the performer could do nothing with my men. An experiment or two without contact but with the uninstructed "agent" following Romano at his heels, were fairly successful. This was a case of muscle-reading disguised; the interpretation, by hearing, of the tendency on the agent's part to keep evenly behind when the performer is nearing the hidden object, to hesitate and slightly deviate in its direction when he is going wrong, et cetera. Romano had a very sensitive nervous organism, and probably very acute hearing. He failed utterly when all sat still, thinking intently of the place where the object was concealed.

Very recently a supposed Egyptian "fakir" (said to be of European birth) who calls himself Rahmen Bey, gave his "mind-reading" show in a Boston theatre. Dr. J. B. Rhine of West Virginia University and his wife, also a Ph.D., attended with me, and it happened that we had been talking about the method of defeating muscle-readers by letting the muscles go limp. Both are curious about claims of a psychological sort and both went upon the stage when a "committee" was called for. It proved that this "fakir's" method was disguised muscle-reading. Instead of constant contact he let his fingers flutter, now touching the hand of the accompanying agent, and now momentarily free in the air. The unconscious motor impulses on the part of those who do not know the method, can be interpreted in that way nearly as easily as by continuous contact. What followed is worthy of a longer description than I can spare. The two Rhines "crabbed" nearly the whole act of the "fakir" because he spent most of his allotted time trying to get some muscular response from the two in turn, using all the expedients and guesses that experience had taught him and vainly trotting them all over the platform. He even took Mrs. Rhine down to her seat in the front row, without avail. It finally became so funny that the audience tittered, and it must have required all his "years of ascetic discipline" to preserve that Buddha countenance of calm, while inwardly uttering "damns."

A little Japanese "professor" once tracked me to my lair, to demonstrate mind-reading with his little wife. It was the straightest muscle-reading, and I think neither of them knew it. After she had entirely failed in locating an object, I asked her to try again, assuring her that she would now succeed, and she did, apparently without realizing why. Her husband swore by all the Japanese gods that it was not muscle-reading, and got so excited that she was unable to do her little act even with him as agent.

Blindfolds That Do Not Blind

Several years ago a handsome young Spaniard, Argamasilla, came to this country, claiming that he had discovered that he could see through metal. He had convinced several persons eminent in connection with physical phenomena abroad. Describing small articles in a silver box, and telling the position of the hands in a closed front watch were his specialties. But it would perhaps be easier to think that telepathy was involved, and in fact we were told by him to set the watch hands at random so that he could not be said to read our minds. His "business" was exquisite. He had a pad over his eyes and a handkerchief tied over it, but the tilted head betrayed that he was squinting down alongside of his nose. With the window at his back and the watch in his hand, he moved the watch at different angles, varied the distance from his face and tilted his head this way and that, "to get the focus." Then he steadily looked down through the pad and cloth (?) at the watch, now exposed in his open palm. But the job had already been accomplished (exactly as "spirit" writing is already on the slate when you begin to hear sounds of writing).

In the course of "getting the focus" he had opened the cover slightly, and peeked down along his nose at the hands. The box was similarly peeked into. It is not much to tell but it was charmingly done. Houdini solved the wonder and duplicated it. Carrington independently solved it. And Argamasilla's piercing physical or mental sight ceased to work, when I fastened the cover of the watch, and tied a bit of tape around the box. He made no complaint, he could not without confession—and promised to try again, but was ill at the next appointment, nor did the poor fellow ever feel well enough to see me afterwards.

There are other interesting methods and other prominent exponents of spurious telepathy, but I have not space for them. Later I shall present an article on cases in quite a different category, some of which present strong credentials of being genuine telepathy.

RAHMEN BEY, FAKIR

Did he say "damn" when two investigators spoiled his muscle-reading act by failing to cooperate

THE SECOND MRS. ZANCIG, THE FIRST MRS. ZANCIG AND JULIUS ZANCIG

The Zancigs fooled four presidents and a whole flock of kings and queens. Singularly, the second Mrs. Zancig had the same remarkable powers of being able to "read minds" that the first Mrs. Zancig possessed!

Our Point of View

Centenary

IT is surprising that the recent centenary of the opening of the Erie Canal should not have attracted greater attention than it did; for the completion of the canal marked a great epoch in the history of the United States. It was the first attempt, on a grand scale, to unite far-distant sections of this country by an adequate line of transportation for passengers and freight. New York, as a whole, seemed to pay but little attention to the pageant of ships which sailed down the Hudson River in commemoration of the opening of the Erie waterway, and yet, it is not disputed that to this shallow canal with its diminutive barges New York owes its present industrial and maritime supremacy. The new canal—double the depth of the original waterway—will never hold the relatively important position which marked the first few decades of canal operation; but if it can only be kept free from the curse of politics, and its maintenance and operation be placed in the hands of skilled engineers and shipping men, we believe that it has a most important future before it, particularly as an honest competitor with the railroads and as a controlling factor in the matter of rates.

Scientific Property

"WHAT recompense is offered by modern civilization to the men of science who make great discoveries which will perhaps bring about marvelous changes and enormous advantages to industry and enable others to become fabulously rich? Nothing! In other words, jurisprudence, which, in the course of its evolution, has already succeeded in evolving and protecting the rights of the author and inventor, has not yet succeeded in evolving the rights of the man of science nor in finding a means of rewarding him."

Thus Senator Ruffini, quoting the Italian writer, Luzzato, states the case for the research worker in pure science for whose achievements, however great, there is no material reward. The Committee on Intellectual Cooperation of the League of Nations has approved Senator Ruffini's masterly report and has adopted a resolution declaring: "A new right should be created for scientists whose discoveries have been profitably applied."

This new right has been called "scientific property." It may be defined as a property right in a scientific discovery, similar to that which inventors and authors enjoy with regard to their creations. In other words, the scientist would obtain a quasi-patent for his discovery with the privilege of deriving a royalty from any manufacturer who applied the scientist's new principle to an industrial product.

Arguments there are, of course, against the project. It is more than a coincidence that the objections to the creation of scientific property are precisely the same as those advanced against the creation of a patent system; yet who today will deny that the patent system is one of the most important cogs in the machinery of modern progress?

John H. Wigmore, dean of Northwestern University of Law, declares in a letter to the writer:

"I would say that I regard the subject of scientific property as one of the most immense significance in the near future. The Scientific American would do well to stimulate discussion upon it. Hitherto, in this country, no attention has been paid to it, but the matter is well under way in Europe; although, as this country stands at the head in practical inventions, and among the first in scientific discovery, we ought to be more deeply interested than any other people."

Fortunately, however, there are signs that we are about to become more alive to the problem. The value of research in pure science is recognized as never before. As one of many tokens we have the effort of Secretary Hoover and the National Academy of Science to raise a fund of 20,000,000 dollars that scholars with suitable equipment may discover new worlds for industry to conquer. It is not enough, however, to provide men merely with tools with which to work. There must be a fitting reward for these men who blaze new trails. For a man, whose discoveries make possible a long step forward in civilization, to suffer, while others wax rich from the application of his principles to industry, is a crying injustice.

By what system can the scientist share in the rewards? Perhaps by the method suggested by M. de Torres Quevedo to the Committee on Intellectual Cooperation—creating a tribunal to establish priority of scientific discovery and granting to the scientist a right of authorship so that he may enter into agreements with subsequent inventors or manufacturers. Always, however, there must be a recognition of this principle—no scientist who is alive to the ethics of his profession, may stay the march of progress by preventing the application of his discoveries by others in the field of applied science. The problem is an intricate one, but its solution is being sought earnestly, intelligently and with sympathy.

Charity on a Business-like Basis

If modern business methods were used in the administration of the monies that are so generously contributed for charity, the practical benefits, in the alleviation of suffering, could be doubled. But, as matters stand, we fail to find in welfare and hospital work that combination of economy and efficiency which have won for American business methods an approval that is worldwide. Thus, we are told by the executive offices of the Joint Administrative Board of the Medical Center, New York, that not one-third of the hospitals of the country accept modern business methods. When it is stated that the value of hospital property in America is estimated in billions of dollars and that more than half of the hospital cots in the world are in this country, the lack of up-to-date business methods in so many of our hospitals is as serious as it is amazing. Instead of hospital rates falling, they are rising, until today the services of a first-class surgeon in a first-class hospital spells bankruptcy for your average-salaried man. And this is, after all, but one phase of so-called charitable work. There are the thousand-and-one appeals, generously answered, for charity in its manifold forms. What with heavy overhead and duplicated service, the ultimate relief to suffering is often woefully small. There is no fraud in this; but there is woeful inefficiency.

Junketing

THERE is a growing conviction (and it cannot grow too fast for the interests of Uncle Sam) that there is altogether too much political junketing carried on under the camouflage of so-called commissions and committees of investigations. Governor Smith of New York recently gave the state legislature some snappy talk on this subject. Referring to the fact that more than forty bills having to do with the "open season of fox squirrels, the taking of lobsters from lobster pots," et cetera, consumed the time of the New York Legislature's last session, he said to the legislature, "the sensible thing is to empower the Conservation Commission to make rules and regulations covering the taking of fish and game and wild animals." Of course. In spite of the fact that we have a highly competent Forest Service, the federal government had to appoint a sub-committee of the Senate Public Lands Committee to investigate the question of grazing on the national forests—a most costly work which has resulted in little constructive or helpful. How could it? The enterprising lawyers who get themselves elected to Congress are not qualified to pass on a special subject such as this. Let the cobbler stick to his last. If Congress and the state legislatures would cut out these junketing committees, the country would be saved an immense amount of valuable time and the expense of hundred of thousands of dollars.

Houdini

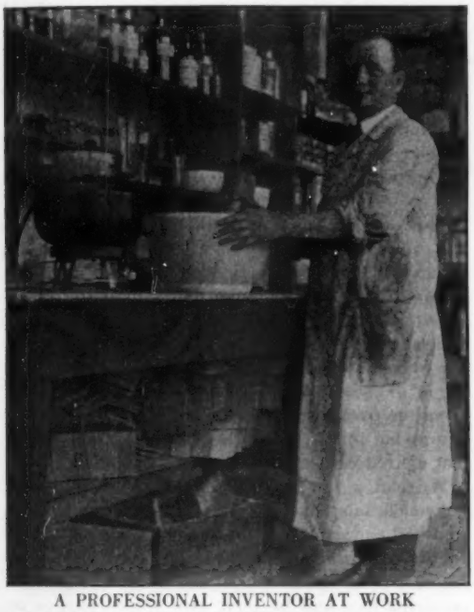
BY the recent death of Harry Houdini, there passed out the most famous "magician" of his time, and as some would have it, of all time. Over and above the great popularity due to his amazing cleverness, there was a note of honesty and sincere purpose about the man which added greatly to his undoubted popularity. His performances were characterized by a truly wonderful technique, and so versatile was he that he covered both the field of what we might call table magic, which required not much apparatus but a marvelous dexterity of hand, while, at the same time, he stood in a class by himself in the field which won him his greatest reputation, where he performed his feats with the aid of special costly and very heavy paraphernalia. It was probably due to his inborn honesty of character that he seemed to find more satisfaction in his successful exposure of imposture and fraud than in those brilliant feats of legerdemain and escape from handcuffs, prison cells and sealed metal caskets, which in the eyes of the world at large, seemed to border upon, if they did not actually enter the region of the supernatural. It was this fact which led to his inclusion on the committee of the Scientific American for the investigation of so-called spiritualistic phenomena, in whose investigations and conclusions he rendered valuable assistance. In addition to his professional work in public, he devoted a large amount of his time and means to the collection of all available literature that he could lay his hands on that dealt with magic, necromancy and so-called spiritualism. His library covered an immense field and contained some of the most ancient literature upon these subjects. He claimed—and probably the claim was well-justified—that there was no other library of the kind in existence that approached his in completeness and variety. The bulk of this collection was willed to the nation and will probably find a resting place in the Congressional Library at Washington, D. C.

Inventors Who Have Achieved Commercial Success

The First of a Series of Interviews With Men Whose Inventions Are Bringing Them Fame and Fortune Today

By Milton Wright

IF you have kissed a pretty girl on the cheek recently the chances are that the powder you tasted was dabbed out of a little vanity case invented by a certain William Garfield Kendall, who has a little laboratory in Newark, New Jersey. Or perhaps the powder was not dabbed out, but was rubbed from a hard cake in the young lady's vanity case. No matter. The cake—"compact," they call it in cosmetic circles—was invented by the same



A PROFESSIONAL INVENTOR AT WORK

Mr. Kendall is a hard-headed business man who has made a financial success out of patented inventions

William Garfield Kendall. So, also, in all probability, was the case itself, as well as the little metal mirror that often is placed between the rouge and the powder.

Now there are millions of young ladies like the one you know. That is to say, there are millions who powder their noses, and almost as many who rouge their cheeks. This fact makes Mr. Kendall a successful inventor. He holds 75 or 80 patents on his inventions; as to the exact number he himself has lost track.

In such a highly specialized and competitive field as perfumery and cosmetics surely a man must have spent a lifetime of study in order to be so successful, we reasoned. We determined to ask Mr. Kendall about it.

"How did you come to make all these inventions of yours?" we inquired.

"Why, I just saw what was needed and set to work to find how to do it," he replied.

"But what training did you have? How did you ever get started?"

"Well, I think you can say I really got started when I was a boy, although cosmetics was the last thing I ever dreamed of getting into. There were 13 children in our family and we youngsters were not allowed to loaf. I had a job in a machine shop in Jersey City at a dollar and a half a week. Mother was a great one for teaching us thrift. She made each of us take shares in a building and loan organization. I had to pay five dollars a month for that. By the time I was ready to strike out for myself I had 1,000 dollars saved up. I put this money up with another young fellow and we started a little business manufacturing jewelry novelties. By hard work we built it up to a 28,000-dollar business.

"Then came the panic of 1907. We lost everything. I took a job selling jewelry novelties to the trade. It seemed like hard luck, but it really was the opportunity I needed. In the stores I visited I saw vanity boxes of glass and porcelain fall and break and the powder spill out. I invented a new box of metal—that was easy. But how to prevent the powder spilling out—that was a harder problem.

"Over in France they were making powder in a hard cake, but they were putting gum acacia in it to make it stick together, and baking it. The process was cumbersome and the product not so desirable. A powder compact was needed which would have in it nothing but talc and distilled water. For four years I worked away trying to perfect a formula that would work. At last I succeeded."

Professional Inventing Pays

"And then you got a patent, leased it on a royalty basis and sat back and counted your profits," we interrupted.

"Not by a whole lot," he asserted. "There is more than that to successful inventing. There had to be a vanity case designed to hold a hard cake rather than loose powder, a plate to mold the cake, a way to fasten the plate in and a means of ejecting the plate when it is empty. Each of these had to be invented separately."

"Manufacturers readily admitted the value of these inventions, didn't they?"

"Well, they didn't exactly jump at them, but they were willing to be shown. The best I could get was a year's contract with one of the most widely known perfumery manufacturers in the country. He gave me 25 dollars a week and a little corner in his factory. We had to prove that the new product would sell.

"When the year was up and the new powder compact had proved a success we, of course, made vastly different arrangements. Other manufacturers wanted the new compact; I leased it to them on a royalty basis. Then the French manufacturers wanted to adopt it in place of the method they had been using for years. I leased it to them, too."

"But you have had other inventions?" was our next query.

"Oh, yes. New styles become necessary in vanity cases as in anything else. Little improvements occur to me and I work them out."

"Have all of your inventions been in the same field?"

"Most of them. It is natural that they should be. An inventor generally can do his best work in the field he knows best.

"I worked on one invention out of my regular line, but, curiously enough, it led back to an invention in my own field. I had an idea for a new kind of stethoscope for doctors. I was visiting a friend, Dr. F. S. Mason, and talking to him about it. There was a can of talcum powder in his office—one of the kind with sprinkler holes in the top. The holes were open. The doctor happened to look at it and exclaimed:

"'Now why cannot somebody invent a can of talcum powder that would close itself?'

"'Do you mean that?' I asked.

"'Certainly,' he replied. 'Talcum powder ought to be kept clean and sanitary. How can it be if the holes in the top are left open?'

"Here was a job to be done right in my line. The stethoscope was interesting—I may perfect it yet—but the talcum powder problem was just the kind I knew how to solve. I went home and worked out a self-closing top for a talcum powder can and took out a patent on it. I sold the patent outright to a manufacturer for 25,000 dollars."

"Do you sell all your inventions?"

"No. I lease some of them. Take the plate for holding the powder compact, for example. They are all made by one manufacturer. I get a dollar for every thousand of them. That sounds like a small royalty, but remember they are made and sold by the millions. After all, a small royalty and a big volume of sale is a lot better than a big royalty on a few sales. Most inventors will agree to that."

"Would you say it pays to be a professional inventor?"

"Why not? There is a very definite need for inventions. And why should inventions not be made by a man who specializes in producing them, especially when he takes up a particular field? There should be a reward for a man who gives the world what it wants, even though it is only luxuries, as in my case. At any rate, being an inventor has paid me."

"And have you any suggestion to offer a man who is thinking of taking up inventing as a career?"

ONE OF MR. KENDALL'S INVENTIONS

A profitable patent was allowed on the small circular metal plate that holds the compact powder cake

"Yes. It is this: do not overlook the fact that your hardest work comes after your invention is made. Find a definite need for an invention, work out your invention thoroughly and get the best kind of a patent you can. Then bring into play all the business sense you have to see that your invention gets on the market. If it is good the public will take it. There may be attempts at infringement, but such attempts are only evidence that your product is good. I have been fortunate; I have never sued or been sued over a patent."

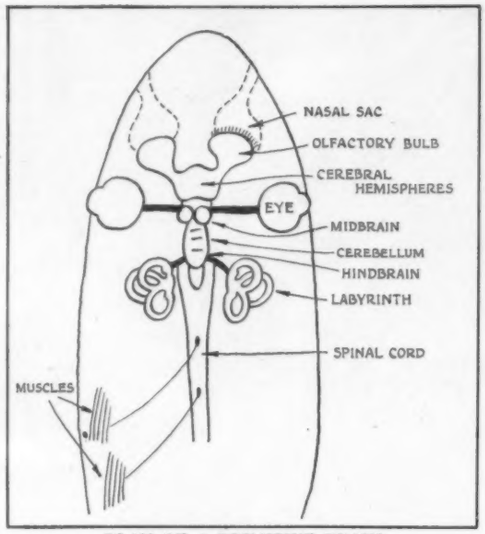
ments that Professor Parker made some years ago to interpret the behavior of primitive vertebrates, and have called attention to the motor reaction that occurs when a piece of attractive crab-meat is thrown into a pool containing hungry dog-fish. But other changes than mere movement are provoked by the scent of the meat. The animal is thrown into a state of intense excitement. It literally quivers with emotion. It gets by smell a foretaste of the food it is going to seize, and its appetite is excited by the anticipation. The emotional expression is one of the objective signs of the fact that the animal's internal organs are being stimulated in preparation for the reception of food. We know how when we ourselves are hungry and smell the sweet savor of attractive food the mouth "waters." The stimulation of the nervous mechanism controlling the organs of digestion, of which the salivary glands are a part, is thrown into activity. They are getting ready to prepare for the digestion of the food.

Sight Evolved After Smell

It is important to bear in mind, then, that in this olfactory experience two more or less distinct events happen. The animal is stimulated to go in search for the food it scents, and in the second place its digestive organs are being put in readiness to do their work when the food is obtained. But although these two phenomena are more or less distinct the one from the other, it must not be assumed that they are wholly disconnected. The animal, in fact, is stimulated to search for the food because, being hungry, its appetite is stimulated by the scent. The awareness of the attractive qualities of the food is the incentive that impels the creature to exercise its discriminating powers and consciously appreciate the attractiveness of the stimulating object. In other words there is the closest possible interrelationship between the two phenomena that express themselves in the animal's behavior, partly by its movements and partly by the changes in its digestive system and the emotional expressions that anticipate the satisfaction of its appetite.

In Figure 2 the arrows A, B and C represent the course of the currents involved in the movement, and D, E, F and G those involved in the visceral activities; but at every level there is a close correlation (between A and D, B and E, and so on).

In addition to its control of behavior, the sense of smell exercised a profound influence upon the course of development of the brain and mind. The state of consciousness in many, if not most, living creatures is a series of unconnected experiences that leaves little or no record. Whereas the animal is



PLAN OF A PRIMITIVE BRAIN

FIGURE 1: *The forebrain is concerned mainly with smell; the midbrain with vision and motor control; the hindbrain (labyrinth) with equilibration*

aware of a particular experience at a particular moment, these separate states of awareness were not at first linked with what went before or with what comes afterwards in such a way as to make a continuity of consciousness between the past and the future.

One of the things the intimacy of the anatomical connections between the various parts of the vertebrate brain makes possible is the linking of past experience with the present, and eventually of anticipating what is going to happen in the immediate future. This function is more particularly associated with the forebrain, which at the time the plan of the brain was originally determined, was concerned mainly with the sense of smell. It is the olfactory functions of the brain that primarily confer upon experience this aspect of coherence by the addition to the consciousness that resides, so to speak, in the forebrain of a series of sensory experiences other than those of smell. A primitive vertebrate whose eyes are stimulated probably appreciates nothing more than the varying degrees of luminosity and movement in the outside world. These events have no inherent significance beyond a consciousness of light and movement.

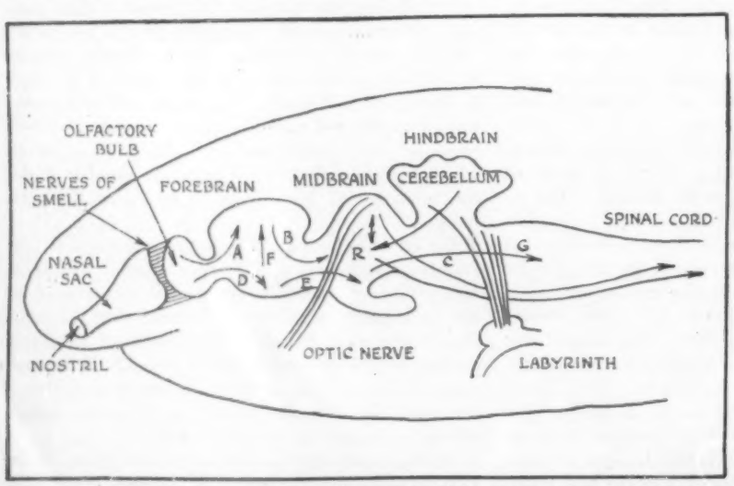
But the sensation of smell is an experience that has an implicit meaning. The forebrain is the seat of the activities that provoke the most vivid consciousness, and at first these activities are provoked especially by smell. Smell in the primitive water-living animal is much more nearly akin to taste, and its significance is innate in the organism. When the creature scents food it gets, so to speak, a foretaste of the consummation of the reaction—an experience that has a definite meaning, such as no other sensory experience has until it is associated with smell and the activities of the forebrain. Throughout the whole of the time that elapses after such an animal scents food, pursues it and eventually seizes it, tastes it and swallows it, the creature is under the continuous influence of olfactory stimulation. In this way the whole series of events, experiences of movement, touch, et cetera, become added to and blended with the olfactory consciousness, and become linked up not merely the one with the other, but also with the culmination of the whole episode. Then the foretaste becomes merged in the actual taste, and the object of the search is realized by the anticipation being linked in experience with the consummation and the feeling of satisfaction it brings.

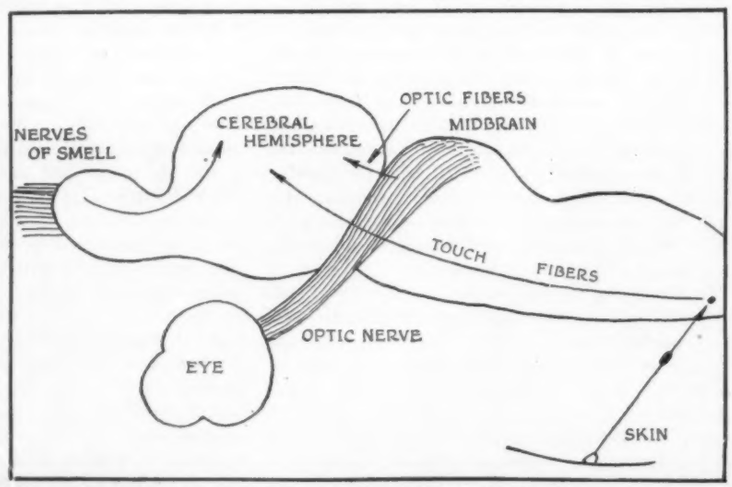
How Animals Came to Have Eyes

It must be apparent that this chain of events makes it possible for the animal to anticipate the seizing of food, and to link together in time and in space a series of events that are essentially as separate as the different pictures in the cinematograph film, which can be blended into a moving picture. These possibilities are created by the structure of the vertebrate brain and represent the germ of the power of associative memory, and in fact, of the ability to learn by experience. Mental coherence is thus based upon smell, and the cerebral hemispheres which in the earliest vertebrate were the receptive organs for smell impressions ultimately become the organ of mind.

In an interesting series of experiments Professor Pavlov was able to show that in an animal like a dog it was possible by training, to teach it to associate with some feeding reaction an altogether irrelevant sensory experience, such as a particular sound. When the irrelevent stimulus is applied to a dog that was so trained, the reactions associated with feeding, such as the activity of the salivary glands, for example, could be provoked by a stimulus that had no inherent relationship whatever to this function. Pavlov called this acquired automatism a "conditioned reflex."

In the primitive vertebrate one can regard the attainment by the eyes of the ability to appreciate the stimulus of food as, so to speak, a conditioned reflex that has become fixed and hereditarily trans-





EVEN IN THE PRIMITIVE BRAIN, THE SENSES OF SIGHT AND TOUCH ARE BEGINNING TO ENCROACH ON THAT OF SMELL

FIGURE 2, LEFT: A *and* B *are the parts by which smell stimulates in the forebrain the sense of smell, and provokes movements that are guided by the midbrain through* C *(passing to the motor nuclei).* D *is the path taken by olfactory impulses that stimulate the digestive organs (by the route,* E *and* G*) and the appetite which intensifies the stimulus* F *to the cerebral cortex.* FIGURE 3, RIGHT: *Even in the primitive brain a few optic fibers and touch fibers make their way into the essentially olfactory organ of mind, the cerebral hemisphere*

mitted. In virtue of such a development certain fishes (including the dominant and most numerous group of bony fishes) acquire the power of finding their food by sight. Vision, to which such stimuli originally had no innate meaning, thus acquired it secondarily by associating certain moving objects with a particular taste that is attractive.

One finds, in fact, throughout the vertebrate series that there has been a constant conflict for supremacy between the sense of smell and the sense of sight. Primarily smell was dominant: but the advantage of using the eyes to detect food is that they give information not merely as to its presence, but also as to its position and movements in space. Hence, it can be found much more quickly and accurately when the eyes are directing instruments, than when smell alone provides the stimulus. Thus, in the bony fishes, which rely mainly on vision for the finding of food, great efficiency and rapidity of movement are attained.

It is a fact of tremendous significance in the history of living animals that progress in structure —in other words, increased ability and efficiency— is intimately related to the development of new modes of locomotion. Obvious analogies are suggested by the part played in modern civilization by new devices for rapid travel on land or water, or in the air. But there is a vast difference. In a human society improvements in the means of getting about involve little more than a speeding up of behavior. In the animal it involves profound

Drawn by S. F. Aaron

THE FROG, AN AMPHIBIAN

FIGURE 5: *When fish-like animals became amphibians, important alterations of the brain became necessary*

changes in the whole organism, and in particular the directing mechanism or brain.

In many invertebrate animals posture is not automatically regulated with such exactitude as it is in all vertebrates which are readily adapted to quick movements. Without such a perfect means of rapid orientation, the creature's movements are necessarily clumsy and slow. Although the jelly-fish usually carries its bell uppermost, it can move in any direction and in any attitude: posture does not seem yet to have been so rigidly stereotyped as it has, for example, in a fish.

Until an animal adopts some definite and habitual posture and has its shape and the arrangement of its muscles adapted to that particular attitude and mode of progress, it is obvious that rapid and precise movements are impossible. One of the essential factors in the development of a vertebrate animal (Figure 5) is the acquisition of a form that makes rapid movements possible, and with this is also associated the perfecting of the labyrinth and the brain to control the animal's habitual orientation in space. Such an automatic regulation of the animal's attitude is the essential condition for the

Courtesy of the New York Zoological Society

JELLYFISH, THE PORTUGUESE MAN-OF-WAR

FIGURE 4: *It can move in any direction and any posture*

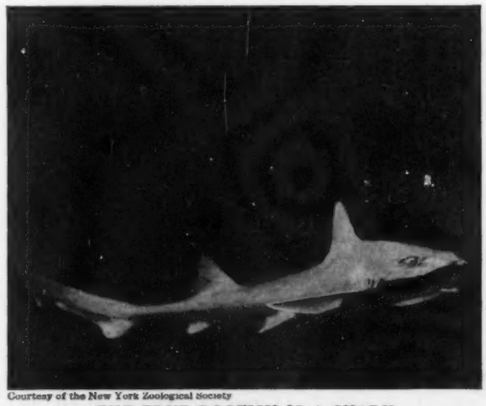
building up of an instrument to direct rapid and precise voluntary movements, free, so to speak, from the distraction of having consciously to regulate posture and position.

When a primitive fish-like animal first left the water to adopt a terrestrial mode of life, an entirely new mode of locomotion had to be adopted, involving profound alterations in the brain. At first the animal used its newly adapted four limbs in a clumsy and inefficient way. A frog can hardly be said to walk as a four-footed reptile or mammal does. It simply flops about or jumps, and these movements are both crude and slow. (Figure 6)

Greater control over the limbs was attained as the result of the growth and development of the brain and in particular of the cerebral hemispheres. This led to the emergence of reptiles, whose movements are both more rapid and more precise than those of an amphibian.

With the cultivation of a greater degree of control over the limbs there emerged from the reptile type two kinds of vertebrates distinguished by exceptional degrees of skill. One was a group of highly modified creatures—birds—whose muscular skill is most distinctively displayed in their ability to fly, an extreme form of specialization, both of limbs and brain. The other group, mammals, retained much more of the primitive structure and developed their powers more evenly and without such a high degree of specialization as that which led to the emergence of birds. Hence, in their development they did not sacrifice their adaptability.

It is significant that in both these higher groups the attainment of greater skill confers upon the creature the ability to raise its body away from the ground. This in turn is associated with an increase of the body temperature and the development of a heat-regulating mechanism in the brain; also of



Courtesy of the New York Zoological Society

THE TRUE DOGFISH IS A SHARK

FIGURE 5: *A relic of a primitive stage of evolution*

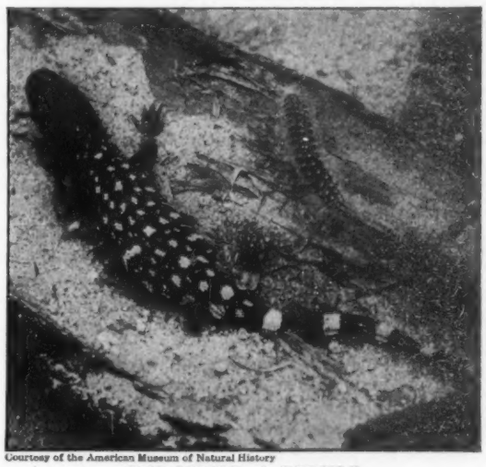
body coverings (feathers or hair) to minimize heat loss. Warmth promotes tactile discrimination and this in turn helps in the attainment of muscular skill.

The new powers of locomotion in both birds and mammals were intimately associated with the enhancement of the functions of the forebrain. The latter acquired a much greater control over the motor mechanisms of the rest of the brain than it had in any of the lowlier groups. This was due to the development of greater representation of the senses of vision and touch than the cerebral hemispheres had in the lowlier vertebrates (see Figure 9). This was especially the case in mammals, in whose forebrain there developed what is known as the "neopallium," an area that gave vision, touch, hearing and in fact, all the senses, much fuller representation in what was originally the olfactory part of the brain.

The development of the neopallium confers upon mammals the possibility of the attainment of much greater skill and adaptability than any other living creatures acquire.

Mammals differ from birds and reptiles in the fact that increased representation of senses other than smell does not interfere with the older mechanisms of the forebrain. Hence, increased representation of the other senses in the cerebral hemisphere does not injuriously affect the original foundation of this part of the brain.

In the primitive animal, especially fishes, the



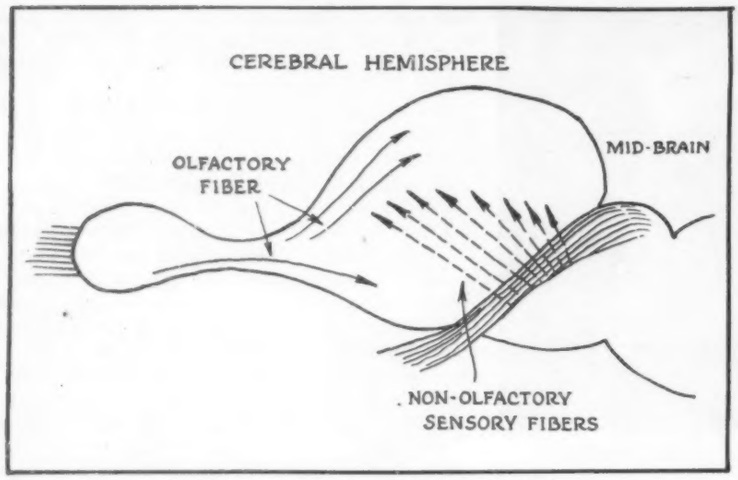
Courtesy of the American Museum of Natural History

THE LIZARD, A REPTILE

FIGURE 7: *Reptiles evolved from amphibians when the brain permitted greater control of the limbs*

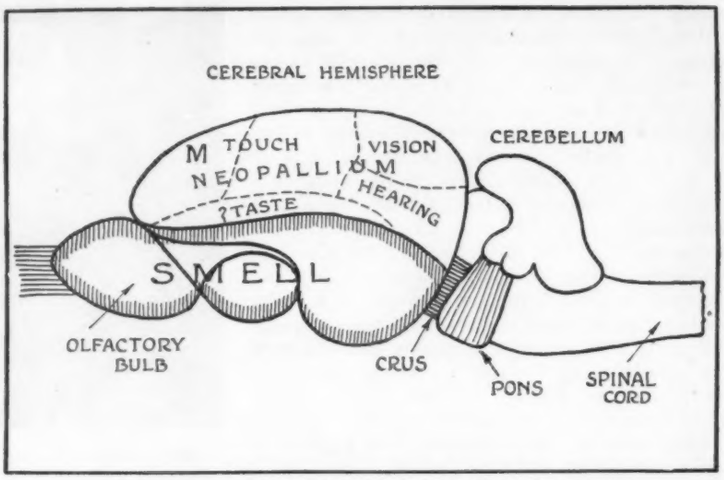
dominance of vision, although making for greater efficiency in movement, destroys the possibility of a further progress in the direction that leads toward the higher type of brain. For the optic nerves are connected with the midbrain, which is concerned mainly with stereotyped automatic activities, whereas the olfactory nerves are connected with the forebrain, which deals with consciously adapted reactions. Hence, the increased importance of vision stimulates the development of the midbrain and automatism at the expense of the forebrain and intelligence. This principle applies also, although not so definitely, in all other vertebrate groups, except mammals.

In reptiles and birds a new factor limits such unrestricted development of the cerebral hemispheres as occurs in mammals. The new nonolfactory formation (hypopallium) in reptiles and birds bulges into the cavity of the hemisphere (Figure 8), so that there comes a time when any further expansion involves stretching and interferes with the free cortex. There are signs of such stretching in most reptiles and even more definitely in birds. In mammals most of the expanding area is on the surface



THE RISE OF OTHER SENSES THAN SMELL

FIGURE 8: *In the reptilian brain, the cerebral hemisphere has grown in size and complexity, mainly because there has been a great increase in the number of non-olfactory sensory fibers (those concerned with touch, vision, hearing, and so on) which add to the efficiency of the cerebral hemisphere of the brain as an organ for exciting quick and exact movements*



FINALLY—THE EVOLUTION OF THE MAMMALIAN BRAIN

FIGURE 9: *The great increase in the size of the cerebral hemisphere is due to the development upon the old "smell-brain" of a new territory, the neopallium, for the fuller representation of touch, vision and hearing, and the development within the touch area of a mechanism (M) directly controlling the motor nuclei in the brain and spinal cord via the crus*

of the hemisphere (Figure 9) and hence is unrestricted.

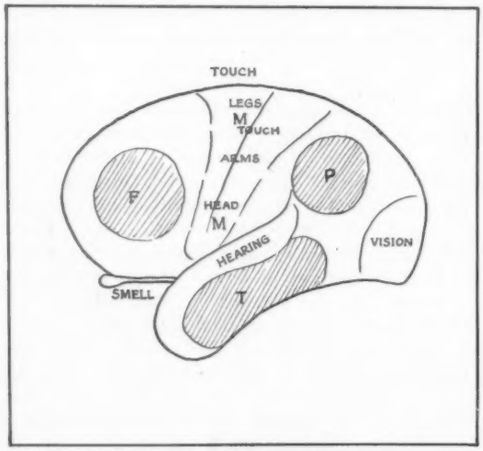
In mammals vision has acquired full representation in the neopallium, which controls the consciously skilled movements of the body, and in addition is the chief instrument of the mind. Hence, vision can become the dominant sense, as it did in man's ancestors, without impairing in any respect the efficiency of the forebrain—the cerebral hemispheres. The cultivation of vision in a mammal, in fact, provides a most powerful stimulus for the enhancement of the powers of the forebrain itself and the growth of intelligence. It becomes the dominant factor in stimulating the development of the cerebral cortex, in the way that leads to the emergence of human characteristics (Figure 10), the use of visual guidance in the cultivation of skill, the full exercise of the discrimination and the increase of understanding.

How a Cat Keeps its Balance

With this progressive development of the brain there is built up in the central nervous system (more particularly the midbrain) a very wonderful and complex system of automatic mechanisms to regulate the posture of the body, which have been recently studied by Professor Magnus of Utrecht, and his collaborators. The body of a four-footed animal, like a rabbit, or a cat, will maintain its normal posture even without its cerebral hemispheres, and without any voluntary act on the part of the animal. The essential instrument in effecting this is the labyrinth, which records the position of the body and its movements in space, so that if the animal's equilibrium is disturbed, this mechanism, operating through the midbrain and hindbrain, will restore the equilibrium. It is helped by other mechanisms, sensory nerves in the soles of the feet, in the skin on the sides of the body, as well as nerves that carry impulses from the muscles of the neck. Hence, even if the labyrinths are destroyed, there are these other means by which equilibrium, or the normal posture of the body, can be automatically maintained without any conscious intervention of the individual. The attention that is due to the activities of the cerebral cortex can be focused upon the performance of voluntary movements and make use of this elaborate machinery in the lower parts of the brain, playing on it, so to speak, as a musician does on a piano.

In the development of man's ancestors, in which the significance of vision as a means of guiding the hands for the performance of skilled movements becomes enormously enhanced (and with it, all the sensory functions of the cortex) it also attains a predominant influence in regulating behavior. To us the world and what happens in it is known mainly by vision. With this development of the voluntary control of behavior there is also an increase in automatic influence of the eyes in regulating the attitude of the body.

In most mammals the mechanisms for regulating posture are not found in the forebrain, but in the region of the mid and hindbrain. In man and his immediate relatives, in which vision comes to play an increasingly large part in the maintenance of posture, the cerebral cortex participates in regulating this function, so that the maintenance of the



THE CROWNING EVOLUTION

FIGURE 10: *Enormous expansion of the neopallium in the human brain, dwarfing the now insignificant smell-brain and even the receptive areas for touch, vision and hearing. The newly-developed areas, Frontal (F) Parietal (P) and Temporal (T) are intimately related to the functions of sensory discrimination and the control, through the cerebellum, of muscular tone and the mechanisms of skill*

normal attitude of the body is brought more within the range of consciousness and the voluntary activities of the individual. Hence, in learning to perform any skilled act, man and his nearest relatives have a greater control over the automatic mechanisms that have to be modified in order to acquire efficiency, for their regulation has been brought under the influence of the neopallium in the forebrain.

The attainment of a high degree of skill necessitates long periods of training before nicely balanced actions are possible. Something more is required than the conscious regulation of a large group of muscles acting in different ways to effect a harmoniously balanced action: the control of a large number of automatic mechanisms must be brought into harmony with those that are under voluntary control. The possibility of acquiring these high powers of skill is created by the fact that the neopallium gradually acquires not only the control of the phasic voluntary movements but also of the static mechanisms that have to be brought into the closest coordination with them before true skill and the sparing of fatigue are attainable. Training involves not only the acquisition of rapidity and precision in movement, but it likewise involves the elimination of the too rapid onset of fatigue.

Muscular Skill Begets Intelligence

It is found in examining the cerebral cortex of man that a very large part of the neopallium is in functional connection with the cerebellum, or with some part of the motor apparatus in the lower part of the brain and spinal cord. The attainment of muscular skill (and with it the enhanced ability to learn by experience) is one of the fundamental purposes of the highly developed type of brain. Man differs from all other living creatures in the range of his aptitude for education, and for learning to perform skilled movements of infinite variety and complexity. His understanding of the nature of things and the nature of the forces acting around him is largely acquired by experiment; and during the process of experimentation, understanding of the meaning of things is acquired. Hence, it is perhaps no exaggeration to say that high intelligence is largely one of the results of the attainment of muscular skill. The development of hands capable of performing skilled manipulations, out of which emerges this higher knowledge and intelligence, and the erect attitude, which by freeing the hands from the function of locomotion enables them to be devoted entirely to skilled movement and tactile discrimination, are not the *primary* cause of man's high state of intelligence. They are merely the means used by the developing brain to achieve these great results. The erect attitude is rather one of the expressions of the enhancement of muscular skill: but in turn it becomes a means of still further adding to this skill by freeing the hands and enabling man to adopt an upright posture. When this happens he is able the better to use his powers of vision, and to bring his body into a position adapted for the display of skill.

PUBLIC ... DETROIT PUB...

Inventors Who Have Achieved Commercial Success

The First of a Series of Interviews With Men Whose Inventions Are Bringing Them Fame and Fortune Today

By Milton Wright

IF you have kissed a pretty girl on the cheek recently the chances are that the powder you tasted was dabbed out of a little vanity case invented by a certain William Garfield Kendall, who has a little laboratory in Newark, New Jersey. Or perhaps the powder was not dabbed out, but was rubbed from a hard cake in the young lady's vanity case. No matter. The cake—"compact," they call it in cosmetic circles—was invented by the same

A PROFESSIONAL INVENTOR AT WORK

Mr. Kendall is a hard-headed business man who has made a financial success out of patented inventions

William Garfield Kendall. So, also, in all probability, was the case itself, as well as the little metal mirror that often is placed between the rouge and the powder.

Now there are millions of young ladies like the one you know. That is to say, there are millions who powder their noses, and almost as many who rouge their cheeks. This fact makes Mr. Kendall a successful inventor. He holds 75 or 80 patents on his inventions; as to the exact number he himself has lost track.

In such a highly specialized and competitive field as perfumery and cosmetics surely a man must have spent a lifetime of study in order to be so successful, we reasoned. We determined to ask Mr. Kendall about it.

"How did you come to make all these inventions of yours?" we inquired.

"Why, I just saw what was needed and set to work to find how to do it," he replied.

"But what training did you have? How did you ever get started?"

"Well, I think you can say I really got started when I was a boy, although cosmetics was the last thing I ever dreamed of getting into. There were 13 children in our family and we youngsters were not allowed to loaf. I had a job in a machine shop in Jersey City at a dollar and a half a week. Mother was a great one for teaching us thrift. She made each of us take shares in a building and loan organization. I had to pay five dollars a month for that. By the time I was ready to strike out for myself I had 1,000 dollars saved up. I put this money up with another young fellow and we started a little business manufacturing jewelry novelties. By hard work we built it up to a 28,000-dollar business.

"Then came the panic of 1907. We lost everything. I took a job selling jewelry novelties to the trade. It seemed like hard luck, but it really was the opportunity I needed. In the stores I visited I saw vanity boxes of glass and porcelain fall and break and the powder spill out. I invented a new box of metal—that was easy. But how to prevent the powder spilling out—that was a harder problem.

"Over in France they were making powder in a hard cake, but they were putting gum acacia in it to make it stick together, and baking it. The process was cumbersome and the product not so desirable. A powder compact was needed which would have in it nothing but talc and distilled water. For four years I worked away trying to perfect a formula that would work. At last I succeeded."

Professional Inventing Pays

"And then you got a patent, leased it on a royalty basis and sat back and counted your profits," we interrupted.

"Not by a whole lot," he asserted. "There is more than that to successful inventing. There had to be a vanity case designed to hold a hard cake rather than loose powder, a plate to mold the cake, a way to fasten the plate in and a means of ejecting the plate when it is empty. Each of these had to be invented separately."

"Manufacturers readily admitted the value of these inventions, didn't they?"

"Well, they didn't exactly jump at them, but they were willing to be shown. The best I could get was a year's contract with one of the most widely known perfumery manufacturers in the country. He gave me 25 dollars a week and a little corner in his factory. We had to prove that the new product would sell.

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"'Now why cannot somebody invent a can of talcum powder that would close itself?'

"'Do you mean that?' I asked.

"'Certainly,' he replied. 'Talcum powder ought to be kept clean and sanitary. How can it be if the holes in the top are left open?'

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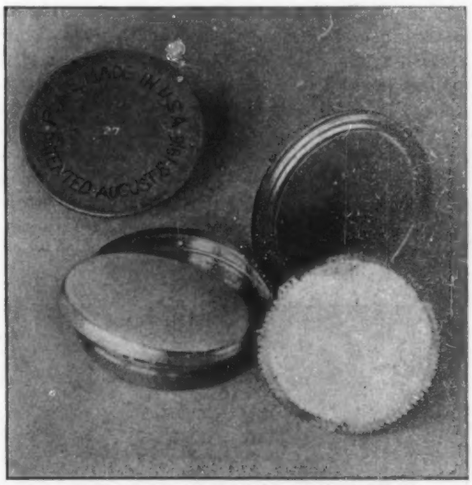
"No. I lease some of them. Take the plate for holding the powder compact, for example. They are all made by one manufacturer. I get a dollar for every thousand of them. That sounds like a small royalty, but remember they are made and sold by the millions. After all, a small royalty and a big volume of sale is a lot better than a big royalty on a few sales. Most inventors will agree to that."

"Would you say it pays to be a professional inventor?"

"Why not? There is a very definite need for inventions. And why should inventions not be made by a man who specializes in producing them, especially when he takes up a particular field? There should be a reward for a man who gives the world what it wants, even though it is only luxuries, as in my case. At any rate, being an inventor has paid me."

"And have you any suggestion to offer a man who is thinking of taking up inventing as a career?"



ONE OF MR. KENDALL'S INVENTIONS

A profitable patent was allowed on the small circular metal plate that holds the compact powder cake

"Yes. It is this: do not overlook the fact that your hardest work comes after your invention is made. Find a definite need for an invention, work out your invention thoroughly and get the best kind of a patent you can. Then bring into play all the business sense you have to see that your invention gets on the market. If it is good the public will take it. There may be attempts at infringement, but such attempts are only evidence that your product is good. I have been fortunate; I have never sued or been sued over a patent."

Science Turns Detective

By Captain Edward C. Crossman

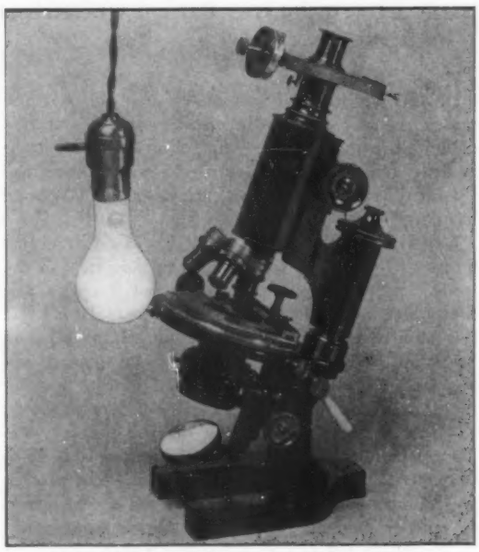
IN these days of scientific research, the person who contemplates "bumping off" a fellow man with the aid of a firearm had best observe a few minor precautions in the proceedings. Otherwise there exists the remote possibility that the shooting might be followed by a demonstration of a modern electrical device in the form of a chair which has never attained the popularity of other electric devices, such as toasters, irons, heaters, and so on.

These minor precautions include tidying up the place at the end of the proceedings, and seeing that all empty cartridges, ejected from the automatic pistol which may be used, are carefully picked up and taken with the party of the first part. Another item is making sure that no bullets are left around, either in the body of the deceased or in adjacent walls, furniture, bedding, or what-not. This requires some care and some skill in marksmanship but it is a requisite nevertheless. If the bullets can be discharged in such a manner as to travel down the street three or four blocks after passing through the recipient, the matter may be termed reasonably "water-tight."

The third precaution consists in taking a nice boat-ride over some very deep water or strolling along the edge of the docks, and during such ride or stroll, allowing the gun used in the affair referred to, to fall into this deep water. It should be done without ostentation or endeavoring to arouse any public interest, because divers might be introduced into the case later on if the prosecuting district attorney felt curious.

The reason for suggesting these precautions to blood-thirsty persons or to "honest" yeggs who may have to shoot somebody in their ordinary night's work in the course of their profession, is because science has evolved methods which make it possible to hitch a fired case or a bullet to the gun whence it came as infallibly as it hitches a fingerprint to the finger which printed it.

More than this, science has made it possible for the trained expert—meaning by this not the gunsmith, not the gun-store clerk and not the person who is a firearms "expert" by virtue of owning a microscope and a book on handwriting—but the trained expert with his equipment and his shop-data files, to take the fired bullet and to say what was the calibre, the type, the maker's name, the approximate serial number of the arm, and the approximate date of manufacture thereof.



MICROSCOPE WITH FILAR MICROMETER

Measurements of 1/100,000ths of an inch can be made with this device. It is used in firearm identification

Nine times out of ten, ordinary instruments of optical precision and ordinary shop-data files pertaining to American and to the best-known foreign pistols, are sufficient to make definite pronouncement as to the gun whence came a fired bullet. At least, this was true up to the past three or four years. The tenth time presented a beautiful stumbling block.

During the past four or five years the frightful dumping of cheap foreign automatic pistols and revolvers into this country—largely from Spain—has so complicated the problem of bullet identification when the gun is missing that there is but one collection in the United States—probably in the world—of sufficient shop-practice data to answer that question in practically any case. This is the work of Judge C. E. Waite, of New York City, Chief of the Bureau of Forensic Ballistics, with whom the writer has the honor to be associated.

There is nothing wrong with the science of identifying the make of gun from which a fired bullet came. All that is necessary is the scientific equipment necessary to take every measurement of the bullet—the pitch of the twist of the rifling, the width of the grooves and of the lands, the depth of the grooves, the caliber of the bullet in general, the weight of the bullet and if possible the identification of the make, which is easy so far as American ammunition is concerned. With the data so obtained, the expert has but to refer to his files of the shop practice of the world's pistol makers, to find who is using just the combination of measurements he has obtained.

In this lies the joker. In some twenty years of intensive study and experiment with firearms, I have never heard of any such collection containing the data of practically every pistol factory in the world—until Judge Waite undertook the work in 1915 and spent the next ten years on the problem.

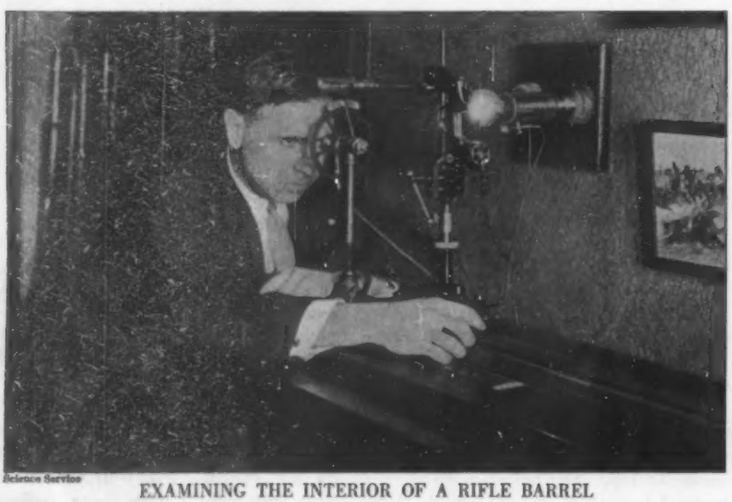
So the expert, minus this manufacturing data, winds up with a dull and sickening thud, when he attempts to identify a bullet from a foreign pistol. He may go into court and bluff the matter through, but not with a well-informed defense attorney on the job.

Most firearms-expert testimony is of the "gets by" variety. It passes muster only because the defense—or the prosecution as the case may be—knows still less and cannot cross-examine the alleged expert and expose the fallacy of his conclusions.

Strangely enough, up to within the last four or five years, Europe has been far ahead of this country in the scientific study of the question of identifying the firearms from which a bullet was fired, or in proving that a bullet came from a given gun, or that a fired case came from a given gun.

We had a few studious, intelligent and earnest police officials, like the great Jones of New York, who had endeavored to go into the matter as deeply as the scientists of Europe. But they were handcuffed by the indifference and stinginess of their municipalities and by their own scanty pay, in obtaining the costly and necessary microscopical and scientific instruments and collecting the essential data pertaining to pistol manufacture.

There were also a few conscientious and studious criminologists about the country—one of them in Seattle, both a criminologist and a practical firearms man, and another in Berkeley—but none of the gentlemen of this class had the time or facilities to concentrate on the one problem which is in itself a life's study.



Science Service

EXAMINING THE INTERIOR OF A RIFLE BARREL

Major Calvin H. Goddard, of the Bureau of Forensic Ballistics, New York, at work with one of the instruments that aid in the detection of crime

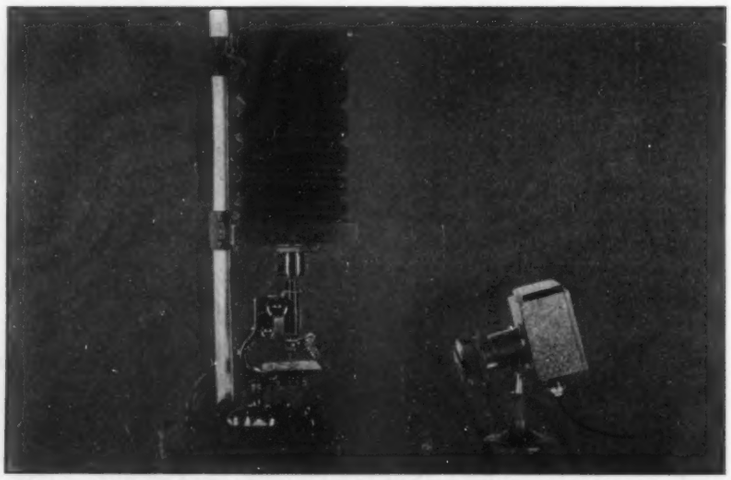


PHOTO-MICROGRAPH APPARATUS FOR FIREARM WORK

With this equipment it is possible to photograph minute details on the surfaces of bullets that have been found at or near the scene of a crime

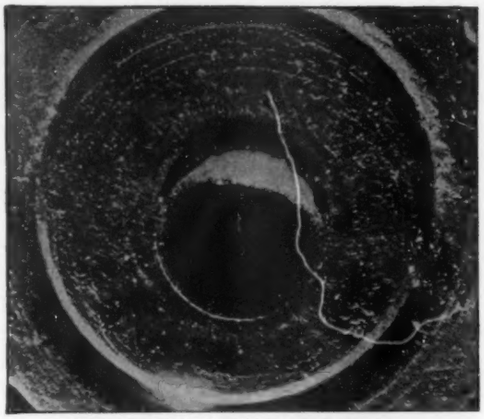


PHOTO-MICROGRAPH OF PRIMER

The concentric lines over the firing-pin imprint repeated in all shells from the same gun and in no other

The problem in legal ballistics which confronts the police and district attorney in firearms cases is practically always under one of these heads.

1. Here is a gun and here is a bullet used in a crime. Did the bullet come from this gun?
2. Here is a gun, and here is a cartridge—empty—found at the scene of the crime. Did the cartridge come from this gun?
3. Here is a bullet used in a crime. No gun has been found. What was the make, the calibre, the type, the approximate date of manufacture, and the approximate serial number of the gun which fired the bullet?
4. Here is an empty cartridge case found at the scene of a crime. What was the make, calibre, et cetera, of the gun which fired it?

Problem number one is by far the most common and suspectible of the most definite proof by scientific methods.

Problem number two is almost as easy to solve and to establish before a jury. But it lacks one link for conviction. An empty case cannot kill a man: what kills him is the bullet. Wherefore, establishing that the case found at the scene of the crime, belonged to a gun in the possession of the suspect, is merely corroborative, not final—the suspect might have fired and missed, the empty case being kicked out of the automatic pistol—and the fatal shot might have been fired by another gun in the hands of another person.

Problem number three, identifying the missing gun from the bullet, so far as the make, calibre, type, et cetera, is one of the nicest problems in legal ballistics and is one which only the man can answer infallibly who has the data of the world's factories at his disposal. Without this data the near-expert may make what he believes to be accurate and definite pronouncement by virtue of similarity of number of lands and grooves in the rifling, pitch, et cetera—and not know that about six other makers use the same standards.

Problem number four—the identification of the gun from which a fired case came is the most unsatisfactory and the least developed. Hitching the case to a given gun is easy; stating from what make the case came from is still difficult and in most cases impossible. A few guns leave peculiar distinguishing marks, such as the cuts made by double extractors, and so on, and all automatic pistols leave their brands as opposed to revolvers.

There are some cases in which both revolvers and automatic pistols use the same ammunition, the most common one being the government calibre .45 automatic pistol ammunition.

This cartridge, used in the notorious Elwell case in New York City, may be fired in the .45 automatic pistol, which may be of Colt, Remington, or Springfield manufacture—or possibly of some foreign make. The cartridge may also be fired in the calibre .45 revolver, made for the United States Government during the war, in the Smith and Wesson Model 1917 revolver, and in the Thompson submachine gun. Hence, an empty case, found at the scene of a crime, might be from any one of these weapons.

The problem of identification of a firearm from evidence left at the scene of the crime divides itself sharply into the following heads; identification of fired bullets; identification of fired cases. Both may be called for in one case but the methods and progress of investigation fall into two sub-divisions.

Links in the Chain of Identification

The first of these is the identification of fired cartridge cases.

Fifteen years ago a French scientific gentleman, Dr. Balthazard, wrote an article going in detail into the marks produced on the fired case by the various steps of loading, firing and ejecting of the automatic pistol. The revolver rarely enters into this problem, because, as a rule, the killer does not take the trouble to eject the empty case by hand at the scene of the crime unless he has exhausted the five or six or seven shots in the cylinder of the gun.

The automatic pistol, however, ejects its empty case with almost the promptitude with which it fires the bullet from that case, and it does this for every shot that is fired. Hence, the fired case is often the evidence remaining, instead of the bullet. Often the two are available, and afford double proof.

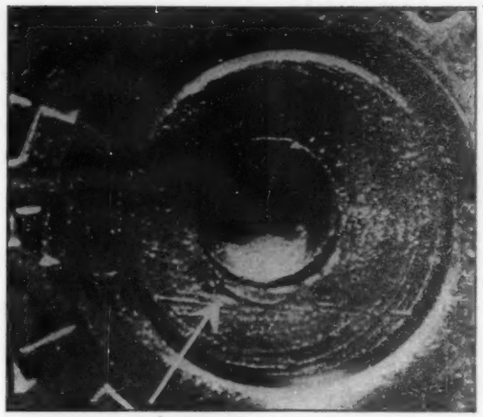
In the operations of the automatic pistol, the slide, or moving portion, is pulled by hand to the rear until it clears the top cartridge lying in the magazine in the grip of the gun or in front of the grip as in the Mauser and Bayard. Released, this slide, driven by a powerful recoil spring, moves swiftly forward, driving the top cartridge out of the magazine, up the ramp of the receiver and into the barrel of the gun.

Here enter the first possible identification marks. Cartridges in the magazine of an automatic pistol are pushed upward by a powerful magazine spring. The slide of the pistol moves backward across this top cartridge, scrapes it in its progress and drives it slightly into the magazine. When the cartridge is driven out of the magazine in front of the slide and into the barrel, more scraping results, against the ramp leading into the barrel, and against the barrel itself. The sides are scraped still more in the process of extracting the empty metallic cartridge case.

Characteristic and repeated scratches on the side of each cartridge tried in a seized gun, formed one

PHOTO-MICROGRAPH OF POWDER

The physical nature of smokeless powder used in pistol bullets is about like that of fine pepper



ANOTHER FIRED PRIMER

The straight lines close to the firing-pin imprint and the concentric lines crossed give positive identification

link in the evidence which hanged seven Egyptians for the murder of Sir Lee Stack Pasha in Cairo, in 1924.

When the slide of an automatic pistol moves forward, the cartridge rises in front of the breech-face and into the extractor hook, which is let into the breech-bolt or slide and which serves to pull the empty case out of the chamber when the gun is fired. This hook, without exception, puts its brand on the rim or cannelure of the case. Its shape and position afford one of the links in identifying a case to a certain make of gun.

When the gun is fired, the firing pin moves forward and drives violently into the primer, which is, as a rule, of soft copper. Another link is forged—or two links as the case may be. The firing-pin point varies from gun to gun. It is made by a turning operation and is hand-finished. The impression of the end of the firing pin is sometimes enough, alone, to link the case to the gun.

The firing pin usually strikes slightly off-center, relative to the center of the primer, easy to understand in view of the tolerance in manufacture of the firing pin and its guide in the breech bolt, the chambering of the gun, the fitting of the bolt in the gun, and the possible eccentricity of the pin. This off-center position, compared with the position of ejector mark and extractor-hook mark, is another hook-up to a given gun.

The violent explosion in the primer itself, and the gas pressure of the powder of the cartridge, drives the primer violently to the rear, where it takes the imprint of any microscopic roughness of the breech-bolt against which it is driven. This is the most definite and scientific identification of the case to the gun firing it.

The breech-bolt face or slide-face of the pistol is finished by strokes of a file. A file-cut which may be smooth to the naked eye, may look like a normal Los Angeles street to the microscope—and I cannot think of anything much rougher, just at present. It is obviously impossible for any workman to file any two pieces of metal alike—in that the strokes of the file do not always run in the same direction, or are they of the same depth and of the same length. Some breech bolts are finished without filing and by a turning operation.

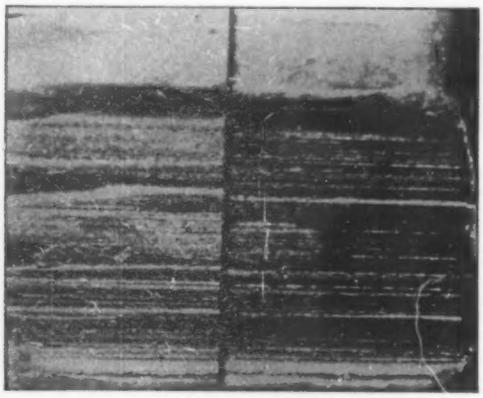
Regardless of which method is used, there are no two breech-bolt faces in the world, even in the finest of pistols, which look the same under the oblique light of the microscope lamp and through the lenses of the microscope.

All that is necessary to discover the many points of difference and to demonstrate them to a lay jury, is sufficient knowledge of microscopy and photo-micrography.

When the pistol is fired, the explosion drives the

breech bolt or slide violently to the rear, the extractor hook jerking the empty case out of the chamber. Near the rearward limit of the slide, a shoulder or blade in the left wall of the receiver strikes the left edge of the empty case, tipping it to the right, out of the grip of the extractor hook and out of the gun through the ejection port. Then the slide picks up a fresh cartridge, carries it into the barrel, and the gun is again ready for another pull on the trigger.

These operations are carried on at a rate of about ten shots per second—provided the trigger does not intervene and prevent the gun from firing itself as



UNDER THE COMPARISON MICROSCOPE

This photo-micrograph of the coinciding groove in two bullets shows the great similarity of the markings

does a machine gun. The ejecting and loading operations, however, are at this rate, so far as their individual movements or travel are concerned.

The violent blow of the case against the ejector blade or shoulder at the rear of the receiver, puts another plain mark on the case. Some automatic pistols, not all of them, also dent the mouth of the case in ejection, probably against the side of the ejection port. The blow of the ejector blade, and the mark of the extractor hook are therefore on opposite sides of the empty case.

We have, then, on the fired case, these marks:

1. Scratches on the sides of the case.
2. A broken or scarred spot from the extractor hook.
3. A firing-pin imprint in the primer, which may be unique to that gun in its shape and in the possible irregularities imprinted in the copper.
4. A firing-pin imprint that may be off-center at all times, relative to the other fixed marks—ejector and extractor imprints.
5. A copper primer, driven back and moulded into the file or tool marks in the breech-face.
6. The imprint of the ejector blade or shoulder.

Very often the shape of the ejector mark, and the shape of the extractor-hook mark differ from those of any other pistol of this make. The cheaper the pistol, or the older it is, the more likely this is to be true.

It is physically and mechanically impossible for all of these pecularities to repeat themselves through a series of shots, except from the same gun. In the same gun, slight uneven spots in the hardness of the brass of the case and of manufacturing tolerance will show slight failures in some marks to appear after some shots and then reappear in others.

The revolver is an arm in which the cartridges are loaded by hand, and gently ejected from the chambers by the same motive power. Its fired cases, therefore, bear no clear ejector and extractor marks, and its identification lies in the always infallible imprint of the breech-face irregularities in the primer. At times the firing-pin point may possess individual peculiarities of its own.

The second part of the problem lies in the identification of fired bullets.

As the bullet is the agent which inflicts wounds or death in a crime in which the gun is used, linking it to the gun found on the suspect or known to be his property or in his possession is practically linking him to the crime.

Briefly, hitching a bullet to the gun firing it is based on the proved fact that no two guns, even of the finest make, put exactly the same imprint on the bullet passing through the barrel. Outside of the shop differences in manufacture, distinguishing guns of different make, the whole field by which a gun and its bullet are linked, lies in the grooves cut in the bullet by the "lands" or raised portions in the gun barrel, a field containing enough individual furrows and humps and clods to remove all doubt, even in the eyes of a jury.

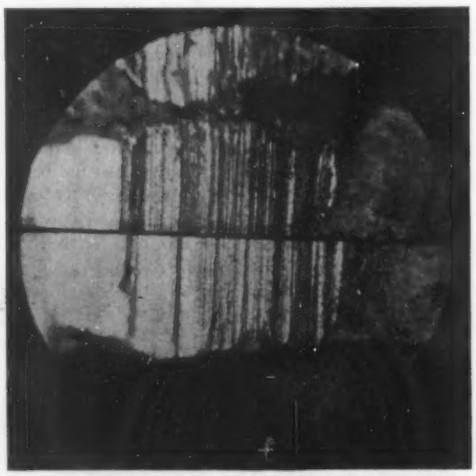
The Barrel "Signs" the Bullet

A pistol or rifle barrel is made by drilling a hole through a round bar of mild steel, slightly smaller than the finished calibre. This hole is then "reamed" by means of a cutting tool having its cutting edges parallel with its long axis and cutting in the direction of its revolution.

The reamed and apparently smooth hole or "bore" is then rifled or grooved, the object being to compel the bullet to spin on its long axis and travel point on.

The number of grooves is another item in identifying the particular make of gun. The width of the grooves and of the lands is still another item. The depth of the groove is a third point. Two factories may be much alike in several of these items, but never in all of them—direction of twist, amount of twist in inches, width of grooves, width of lands, depth of grooves, and calibre between the tops of the lands—the original "bore" of the gun.

After the barrel is rifled, a "lap" is made by pouring molten lead around a steel rod in the barrel so that it takes the imprint of the inside of the bore,



ANOTHER COMPARISON PHOTO-MICROGRAPH

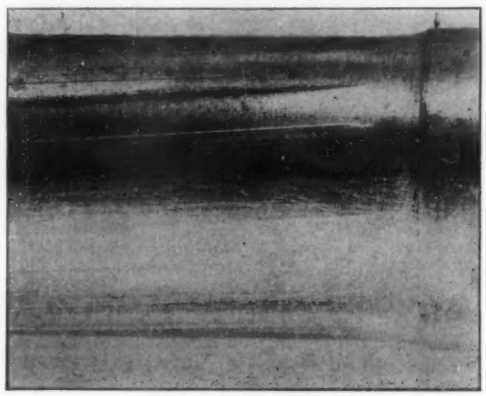
The fatal and test bullets have been lined up and, under the comparison microscope, show that they were fired from the same gun

then withdrawing it, coating it with oil and emery, introducing it into the gun and "lapping" out the roughness and burrs and sharp edges thrown up in the rifling operation.

The finished barrel, looking like a mirror to the casual glance through it, looks more like a railroad switch yard when cut open and put under the microscope. The drill left gouges that in the cheaper guns were too deep for the reaming to remove. The reamer left rings around the finished bore which show on the tops of the lands. Even the final lapping with fine emery, left what are to the eye of the microscope, deep grooves, parallel with the gun bore.

The bullet, either lead, commonly although not entirely used in the revolver, or the copper-jacket or steel-jacket variety, emerges from the barrel bearing the imprint that is the net result of all of these rough spots, gouges and imperfections. Every bullet from this barrel, if of factory standard in size, will bear this imprint.

This "signature" of the barrel is not at all a matter of diagnosis for the gunsmith. It is not a matter of number of lands and grooves, or their width or their twist. It is a matter of microscopic grooves



INSIDE A RIFLE BARREL

Note the roughness of the rifling that is apparent even when comparatively low magnification is used

cut in the bullet by the various peculiarities in the barrel, and every barrel is different. It is mechanically impossible to make any two things exactly alike—and equally so to have all the minute imperfections of machine tool-work precisely alike. In the cheaper guns, these peculiarities are much magnified and more frequent.

The field of search, as before pointed out, lies first in the grooves cut in the bullet by the lands of the gun. First, being depressed in the bullet, they escape injury in passing through tissue or wood or even bone. Second, being the result of the small part of the bore—the "lands"—they are thoroughly cut into the bullet where the bullet may not have taken the imprint of the grooves very distinctly. Third, these lands, being the original bore, bear all the marks of the original drilling, if the reaming has not removed them. They also bear all the defects left in reaming and are more likely to show scratches from the emery of the final lap, being the tightest fitting part of the barrel.

So, hitching the bullet to its gun is purely a matter of firing test bullets from the gun—of the same make of ammunition—and then comparing them, groove by groove, with the fatal bullet. If they are from the same gun every groove will be similar and match in the fine markings cut in it. If they are not, not a groove will bear any resemblance to any groove on the other bullet when the fine cuts are compared in the comparison microscope.

Bullets also bear secondary or "accidental" marks, as the Belgian police scientists term them. These vary from bullet to bullet and have no bearing on identification except that they may now and then blot out an identifying line, which will reappear however on the next bullet.

These secondary markings arise from temporary conditions encountered by the bullet such as rust pits in the bore which the bullet may tear out in its passage, hard bits of powder residue, particles of road-dust and bits of loose steel. Also they will be graved on the bullet in its passage through whatever stops it—clothes, flesh, bits of bone, et cetera.

They never repeat themselves through a series of test bullets in the way that the primary or major markings do. Wherefore, failure of just two bullets

to coincide in every line means nothing as the secondary lines rarely do repeat or match. But, on the same bullets and on the next 20 bullets will be major lines, graved by permanent conditions in the gun, and they will always constitute a positive identification.

Determining the make and type of gun whence came a bullet, when the gun is missing, is more a matter of scientific measurement and a complete file of shop data than it is of the microscope, except as that instrument is used for measurement. It is only a question of narrowing down the wide circle. The number of lands and grooves—four, five, six, or even seven, eliminates most of the possibilities.

The circle is again narrowed by accurate measurement by a Filar eyepiece capable of measurements as fine as one hundred-thousandths of an inch, of the width of the lands and grooves. More possibilities are thrown out. The depth of the grooves are measured by an Ames gauge or a micrometer with special narrow jaws to enter the grooves on the bullet. More elimination.

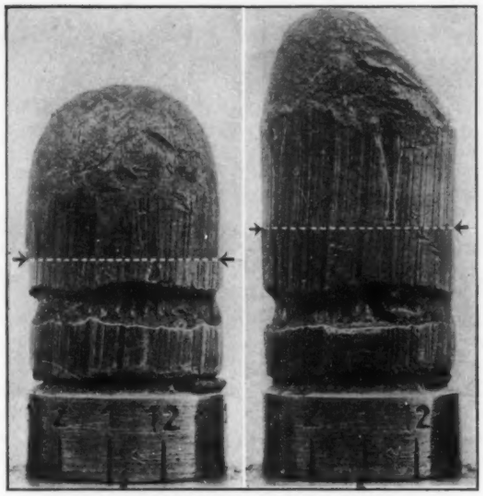
Tools for Forging the Chain

Finally the "pitch" of the gently twisting rifling on the bullet is measured. The perfect system is not yet worked out, the present method involving the use of a divided circle attached to the collar of a micrometer eyepiece containing cross-hairs. One hair is first aligned with the axis of the bullet, then the eyepiece is rotated until the hair is parallel with the sides of the groove and the angle so turned is read off on the divided circle. A rotating stage on the microscope appears to me a more accurate and easily handled method. With this data, the question of the gun is boiled down to one make—often to the approximate date of manufacture and approximate serial number.

Judge C. E. Waite, for years with the Department of Justice, becoming interested in the question of scientific firearms identification through a gross miscarriage of justice in New York State, has carried the science to a far higher degree than it has reached in Europe.

After spending years of work in collecting the factory standards of American pistol makers, even delving into ancient books and interviewing old and retired shop foremen, Judge Waite found his collection nearly useless in the face of the huge influx of foreign pistols into this country after the war.

So, much exasperated, he packed a small trunk and took a larger one for his plunder, and set sail for the foreign countries where pistols are made for export. Armed with the authority of the State Department and accompanied by an army officer, Waite patiently waded through the scores of small European factories, collecting their registered trademarks, their standards, their methods of manufacture, their various models and their numerous trade names. He has, without doubt, the most complete collection in the world of data covering pistols and their identification points.



SUPERIMPOSING THE BULLETS

LEFT: *The lower half is the bottom of the murder bullet while the upper half is the top of a test bullet.* RIGHT: *The upper section of the murder bullet has been placed on the lower part of a test bullet with the markings in line. The markings show that both came from the same gun*

On his return to New York he enlisted the services of Major C. H. Goddard, firearm expert, Phillip Gravelle, well-known photo-micrographer, and John H. Fisher, physicist, and with their aid, proceeded to evolve the essential scientific apparatus for examining, measuring, and photographing bullets.

The equipment as worked out, and being steadily improved, includes the "comparison microscope" using a pair of microscopes and a prismatic eyepiece by which the two fields may be seen in one eyepiece, the "helixometer" by which every inch of the interior of a pistol barrel may be examined under magnification, and by which the "pitch" of the rifling may be measured, various holders for rotating the test and fatal bullets under the fields of the two microscopes, and the triple holder by which the fatal and two test bullets may be rotated together before the camera, and twelve pictures made around their circumference, showing the coincidence throughout.

The Waite system, primarily, consists of the comparison microscope and special holders for making the examination of the fired and the test bullet, or of the fired and test cartridge case. By means of this comparison eyepiece, a groove on each bullet may be brought into exact alignment, each portion on its own side of the very narrow but distinct dividing line in the center of the field. With the sides of the groove cut in alignment, the fine lines—possibly a dozen in a groove—will also align if the bullets are from the same gun.

When two grooves are found in exact coincidence by taking a "zero" groove and comparing the others with it, one at a time, then the two bullets in their special Waite holders are slowly rotated together, bringing each groove into the field of the microscope. If from the same gun, each groove on the two bullets will exactly coincide, minus possible injury in the cases of the fatal bullet.

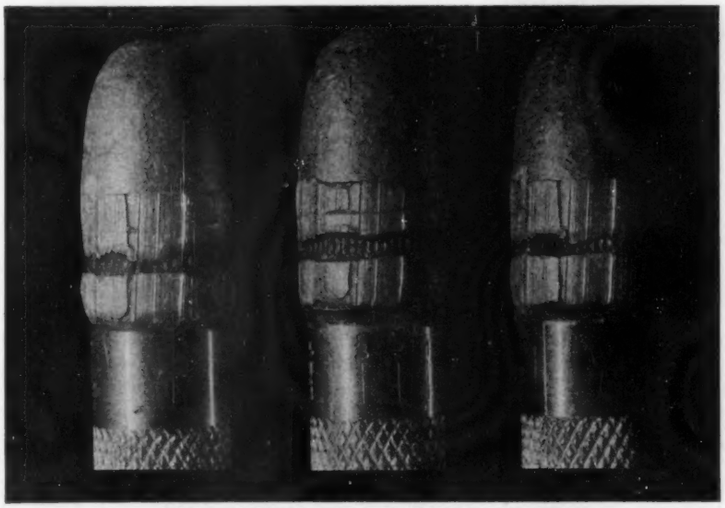
How the Jury is "Shown"

However, it is one thing for the expert to see a fact, it is another to show the fact to a jury. So the Waite system puts the fatal bullet on the center spindle of the triple bullet holder, puts a test bullet on the spindles to the right and left, and matches them up carefully so the start will be made with a coinciding land on all three facing the camera. A photograph is made with about six-times enlargement, showing the three bullets, a cross-light with special lamp being used to bring out the cuts in the three bullets.

The three, on three spindles geared together, are rotated through 1/12 of a circle, and another picture is taken, and so on around the circumference. Each picture shows the same relative portion of each bullet, and each will coincide if the three are from the same gun.

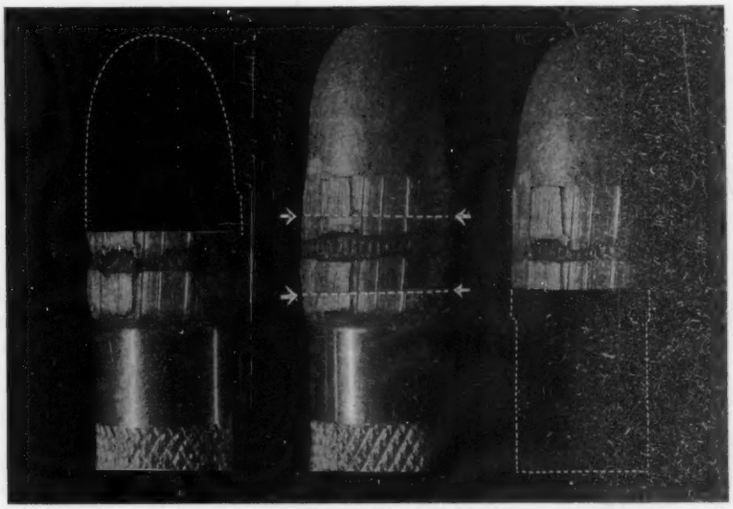
A book containing the 12 prints is introduced into evidence when the trial comes off. In the back of the album are 12 loose prints corresponding with the 12 mounted ones. The jury takes the book into its deliberations. The 12 prints may be cut in half or any other fraction, the cut-off portion moved over and superposed on the print in the album. As the lines on the bullets show clearly, if the lines on the print of a test bullet, cut in half and moved over on the print of the fatal bullet, coincide, then even the jury can see the answer for themselves.

The lines on every groove will coincide—injury of course excepted—if the two bullets come from the same gun. And that is the question to be answered in 90 percent of the cases in which legal ballistics are concerned.



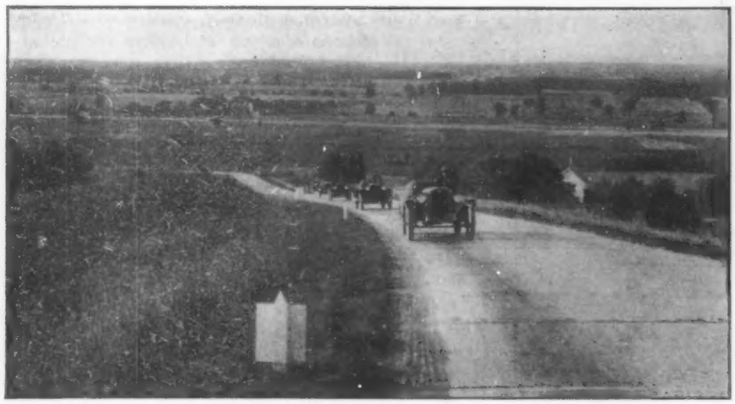
"SILENT WITNESS" IN THE WAITE SYSTEM

In this group, the murder bullet is mounted on the center spindle with two test bullets flanking it on either side. Note how the markings are similar



WHAT THE SCISSORS REVEAL

In photographs, the bottom of the right test bullet and the top of the left were cut off and superimposed on the print of the fatal one, as indicated



ON ONE OF THE CONCRETE TEST HILLS

The road-side signs indicate the gradient. The white line in the distance is the straightaway and a parallel road forming the north side of the speed loop

WORKING UNDER ALL KINDS OF CONDITIONS

Alongside of the concrete straightaway is a pool in which the action of cars in mud, water or slush can be tested, regardless of weather conditions

Applying New "Yardsticks" to Automobiles

Motor-car Proving Ground Demonstrates the Need of Accurate Means of Measurement

By Charles F. Kettering

THE great advance in our industrial progress in the last 25 years can be traced directly to an increasing interest, on the part of industry, in science and research, which involve accurate methods of measuring the different functions of apparatus and materials. Engineering really came into being when men substituted exact methods of measurements for guesses and opinions, and it is on the foundation of exact facts that big industry must build to survive. Engineering research applies ways, means and methods that science has developed to observe, experiment, measure and verify facts.

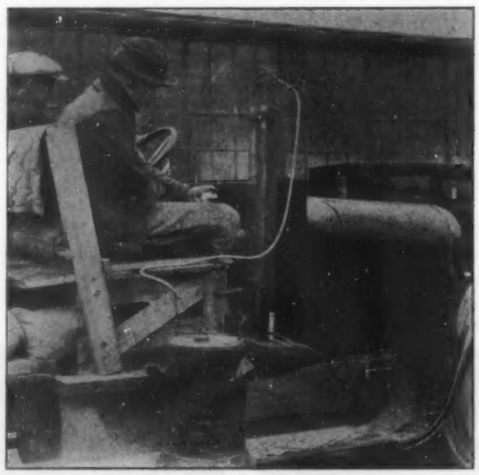
In the rapidly growing automobile business there have been so many factors involved that, until a few years ago, the instrumentation had not been developed to anything like the degree of certainty found in, for instance, the electrical industry. General Motors, through its research organization, has attempted to develop, in cooperation with other members of the great automotive family, such specific instruments as are necessary to measure and evaluate the various parts of the automobile itself. In connection with the engine, instruments have been developed for measuring the explosion pressures, the effects of different fuels upon the engine, lubrication characteristics, crankshaft dilution, crankshaft periods, vibration, horsepower, effects of temperature, et cetera, completely covering the various factors involved in engine design. By use of these measuring instruments, it has been possible to predict the future possible development of the internal combustion engine as applied to the automobile. Great improvements have been made in the power plant in the last few years, both as to durability and as to performance.

Cars Must Stand Abuse

Artificial aging instruments for studying the characteristics of adhesion and long life, have been developed to cover the paint question, and out of this measuring apparatus, in cooperation with the chemical industry, new finishes have been developed.

Springs and body construction have had consideration as far as the measuring of the particular factors which they represent in the construction of the automobile, are concerned.

Each one of the measurements mentioned has been done largely from the standpoint of the engineers. The manufacturer then covers the specific utility of the particular part. The importance of these individual measurements has been realized for a long time, and laboratories have been set up with technical personnels to operate them and to determine these very important engineering facts. However, it has been felt for a long time that the automobile should be measured from the standpoint of the user, or the man who purchases the car as a unit. In view of the recognition that the customer is the final inspector and that he accepts or rejects an automobile in the ultimate by the service it renders, a measuring "instrument" covering the complete automobile has been developed and this is known as the General Motors Proving Ground.



MEASURING FUEL CONSUMPTION

With this testing device, the economy of operation can be determined accurately under driving conditions

Briefly, the proving ground is a place where all types of motor cars may be tested and compared under identical driving conditions. It is a development rather than a conception. Its possibilities so far outweigh its accomplishments, great though the latter may appear, that they befog one's imagination.

The original purpose of the proving ground was to provide a place for the testing of motor-car power and speed without running into conflict with the law. Economical factors were a secondary consideration. Highway conditions had reached the point where satisfactory trying out of new cars or appliances in competition with regular traffic not only was dangerous but practically impossible. The extent of the conception was that, sooner or later, if manufacturers purposed to continue the testing of their products, they must provide their own straightaways and their own hills, on private property, away from traffic interference, where tests involving speed would not be subject to traffic laws.

Seven years ago the engine in a particular car exhibited at the New York Automobile Show was acclaimed by impartial engineers, practically without exception, as the nearest approach to mechanical perfection ever devised. But inside of 12 months that engine was a commercial failure. The engineers were not wrong. The trouble was that an infinitesimal fraction of the owners of motor cars are engineers. The engine was not foolproof; it could not stand up under abuse.

Today, automobile drivers are determining the worth of an engine or a motor car. They are driving cars at the proving ground, under close technical supervision and careful discipline, with the result that the flaws in a new design are discovered and corrected before the factory goes into production with that model. The buyer is saved a great deal of grief; the manufacturer is saved a sizable sum of money and its reputation remains intact.

Standards of Comparison Were Set

In selecting a site for the proving ground, the hills and the straightaways were found on one plot of ground, nearly equi-distant from Detroit, Pontiac, Flint and Lansing, the Michigan cities in which automobile manufacturing operations center. The property was so situated that it was possible to enclose approximately 1,125 acres, or close to a mile and a half square, without blocking any main arteries of travel. Gravel for the building of roads was on the property. Varying grades were a part of the contour of the land. Property values were comparatively low.

That was three years ago. Today, cars are being run over 12 miles of highways at the rate of nearly four million miles a year and the variety of tests listed on charts number 130, grouped under such headings as "Car Performance Comparisons," "Unit Information Test Comparisons," "Maintenance and Operation Comparisons," "Appearance Comparisons," "Comfort Comparisons," and "Specifications."

"HOW HARD DOES THE BRAKE WORK?"
This common question can be definitely answered by the measurements made with the simple device illustrated

How good an automobile may be built is not the only problem a manufacturer has to solve. The price factor is a decidedly important consideration, and the buying public determines the price. Material costs change from day to day. Public tastes vary with the weather or with changes in fashion. If high hats were in style, the low enclosed car with the rakish body design would be out of the market overnight.

The first year's efforts of the proving ground staff were confined almost exclusively to the task of creating "yardsticks." In this task the resourcefulness of the research laboratories was of inestimable value. Simple, automatic devices were designed. Electricity, radio, the cinema and still camera were made to function to meet new requirements. The speedometer, odometer, micrometer and stop watch were adapted to apparatus new and strange to their former operations.

"DOES IT STEER EASILY?"
This instrument, with its second wheel, measures and records the efforts required to steer the car

In the last-named group there are 48 separate items, and in the first named there are 45. In no one of these is anything taken for granted. The tests and checks are standardized. Variables, such as weather, wind velocity, surface conditions and the fickle human element, are checked against, discounted, eliminated through repeated trials. The results obtained today are comparable with those of a year ago today, or years hence.

All this, however, was not brought about in a minute. First the roads had to be built and the grades permanently established. Then, of far more importance, "yardsticks" had to be created, for none existed.

For years the popular place for manufacturers to try out the endurance or power qualities of a motor car has been either the Uniontown hill in Pennsylvania, or Pike's Peak. Speed tests, acceleration and deceleration tests, brake tests and innumerable others have been conducted on apparently level stretches wherever they might be found, but seldom twice in the same place. Obviously, comparisons under such conditions were not accurate and therefore were out of the question.

So, when the proving ground was established, there were no fixed standards of comparison in existence. Car testers, operating five hundred or two thousand miles from the plant were not always reliable, and when they were, the human tendency to err was too great a factor. Not any of the results they obtained were comparable with any other set of records. Each group of engineers had its own pet set of specifications to meet, or approach. Sustained speed tests could not be carried out in traffic congestion. Hill climbing records did not mean very much when the test cars carried varying loads under different weather, traffic and surface conditions, on grades that changed from day to day.

Of Benefit to all Makes of Cars

The devices created, the next step was to establish how well any particular car should perform, how long it should endure, how comfortably it should carry its passengers, how simply it could be operated and so on.

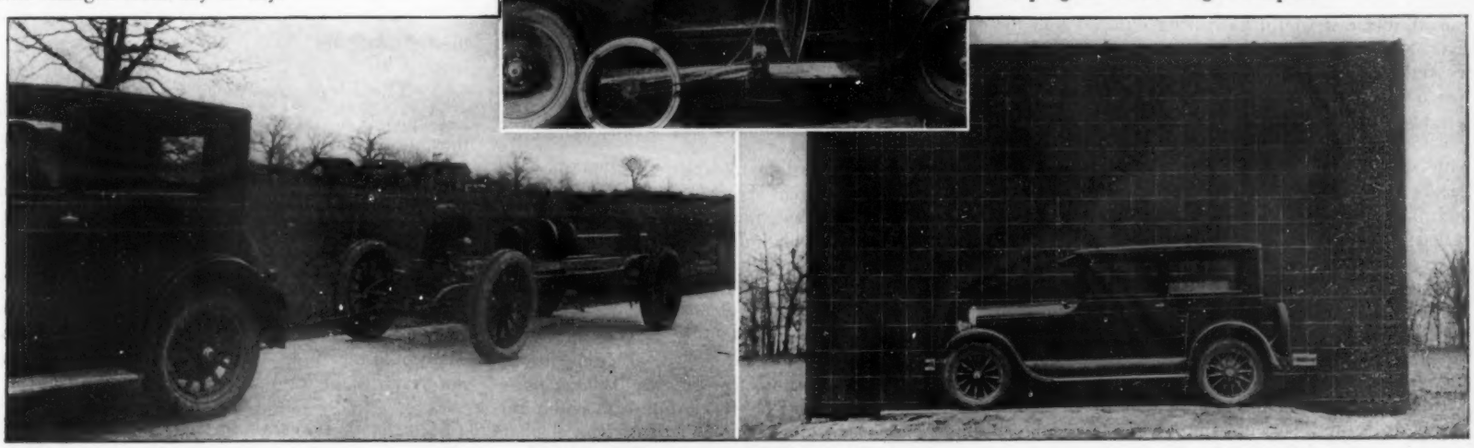
To determine this, all cars manufactured, either in America or abroad, were first grouped into price classes, and each car in each price class put through a standardized series of tests. The records were charted alongside the results of similar tests made on the proving-ground owner's cars in the same price classes. All the cars tested were purchased at retail in the open market. Each car was adjusted and tuned to give its best possible performance and every car in each competitive group was given identical tests under comparable conditions.

The testing goes on unceasingly, day and night, rain or shine, winter and summer. Cars of all makers are on the proving-ground roads constantly, as are also the experimental jobs of the divisions that may be trying out some new device or theory. Whether the drivers are doing staff work or divisional work, neither of which interferes with the other, all operate under a set of traffic rules that minimizes the possibility of accident.

The roads are of all types—gravel, tarvia, concrete and dirt. The speed loop, probably the largest and fastest in the world, is scientifically banked at the turns to a degree never previously attempted. It is four miles long and built for a sustained speed of 100 miles an hour in all weather. The straightaway is level to the degree of zero, a mile and a half long including the loops at either end, built to conduct tests in either direction without shifting gears. The grades for hill-climbing tests are of concrete, staked and marked with the degree of incline at every grade change. The down-grade return loops are of gravel. All traffic with the exception of that on the straightaway is one-way, a safety precaution. A depressed concrete runway, adjoining the straightaway may be covered with water, slush or mud to any given depth up to two feet for the assimilation of actual conditions found at various seasons on the public highways. A chassis equipped with hydraulic brakes automatically operated at any given adjustment provides a drawbar pull to simulate sustained hill-climbing. With the aid of this, the proving-ground staff can predict fairly accurately how a car will perform climbing Pike's Peak or Uniontown hill. An endurance-test road circles the property and leads into and out of the speed loop. It contains up and down hills with gradients as high as 21 percent and 24 percent.

And the cost? No one of the various divisions could afford to finance the undertaking alone, but with the financing shared by all of them, the outlay amounts to less than 30 cents per car on the basis of total production, which now exceeds a million cars a year.

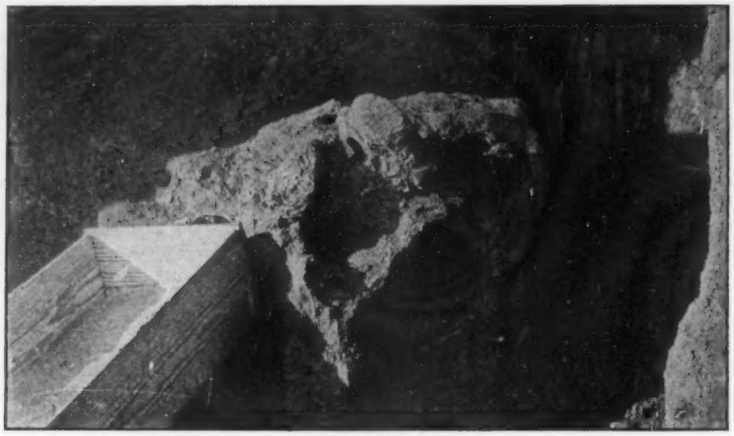
The proving-ground job is a tedious one, oftentimes monotonous, but as a result of it the automobile is being elevated to a higher plane, giving its owner greater and surer service, not only as this applies to General Motors products but to those of its competitors, for they must all meet the advance of progress or no longer compete.



OTHER SPECIALLY DESIGNED "YARDSTICKS"
LEFT: *Chassis equipped with automatic brakes that simulates the effect of hills and makes possible many measurements.* CENTER: *The "fifth" wheel and an electrical recording device indicates acceleration.* RIGHT: *Chart for photographically measuring body lines. Special lenses are used*

THE NEIGHBORS HELPED

The four at the left are digging away at the mammoth's head. Further to the right, two are uncovering a leg. Still others are picking away at the huge ribs



JUST AS HE LAY

Projecting from the skull is the characteristic tooth of the mammoth, with parallel plates which stand out from its surface, giving the appearance of a washboard

Elephant Hunting in Illinois

An Account of the Finding of Fossil Bones of a Prehistoric Elephant, One of Many that Have Been Found

By A. R. Crook, Ph.D.

Chief of the State Museum Division, Springfield, Illinois

IF one should organize an elephant hunt in Illinois he would not have to contend with tsetse flies, water buffalo, lions, long distances, nor African heat. Hardly out of reach of home comforts, during the pleasant days of a mild January, he might find the remains of an elephant on the banks of the Ohio River as was recently done near the little American town with the Hindoo name of Golconda.

At an expense of nearly two hundred millions of dollars, the United States Government is building between Pittsburg and Cairo, 53 locks and dams as traffic officers to give the stop and go signs to the Ohio River.

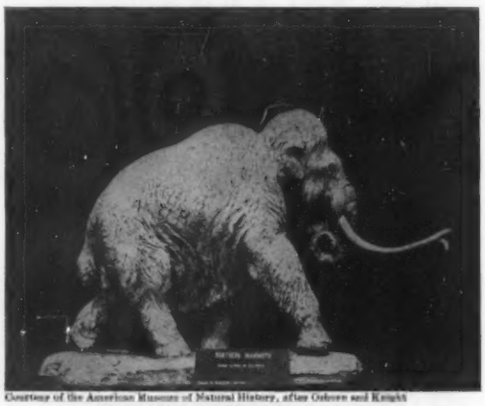
Recently, a steam shovel of the construction company, that is building lock Number 51, pushed its relentless jaws into a bank of dirt and turned up a round white object a foot long and seven inches in diameter.

Tusks Eight Feet Long

Fortunately just as that moment—certainly the psychological moment—a part of the shovel machinery broke. Had it not done so that white object and all the rest would have been dumped into the river. As it was, the observing eye of one of the workers fell upon the white object. He thought it was a piece of fossil wood, but soon discovered a large tooth. Word got around and an engineer and a cost accountant of the company began digging with shovel and trowel. They uncovered a tusk nearly eight feet long and seven inches in diameter and then two more teeth. Then the writer was called in. The hunt soon became a community affair. In one day 60 tons of dirt were handled even while close watch was kept on each shovelful for bones, flint implements and other things of possible interest. When the work seemed to be progressing too slowly, a few charges of dynamite skilfully placed livened things up.

During succeeding days more careful work was required. A few men with trowels, knives and whisk brooms uncovered the remains of an animal as large as an elephant. The bones were in such a poor state of preservation that after the dirt had been scraped and brushed off the top it was necessary to build a frame and cover the bones with plaster of Paris before proceeding to dig under them. When undermined, they were carefully turned over and reinforced with plaster.

In this way some leg bones, a mass of vertebrae and ribs, a tusk eight feet long, one lower and two upper teeth were secured. The outline of the head which measured nearly four feet across, was carefully exposed—a difficult task since the bones were delicate and for the most part so thin walled that



Courtesy of the American Museum of Natural History, after Osborn and Knight

HOW THE MAMMOTH LOOKED

The extinct mammoths and the living "elephants" belong to the same family. Mastodons belong to another family

it was hardly possible to retain them in position. The zygomatic arch showed where the eyes had been. The opening for the proboscis, the tusk sockets and the teeth indicated that the animal had lain forehead down at the time of his burial in the river silt. He had doubtless met his fate further up the river and been transported by water or floating ice to where he was found.

The three teeth well preserved, are those of the northern hairy mammoth—*Elephas primigenius*—with ten cross plates in any portion of a molar surface four inches long. The modern African elephant tooth has five cross plates in that distance, and the Indian elephant eight.

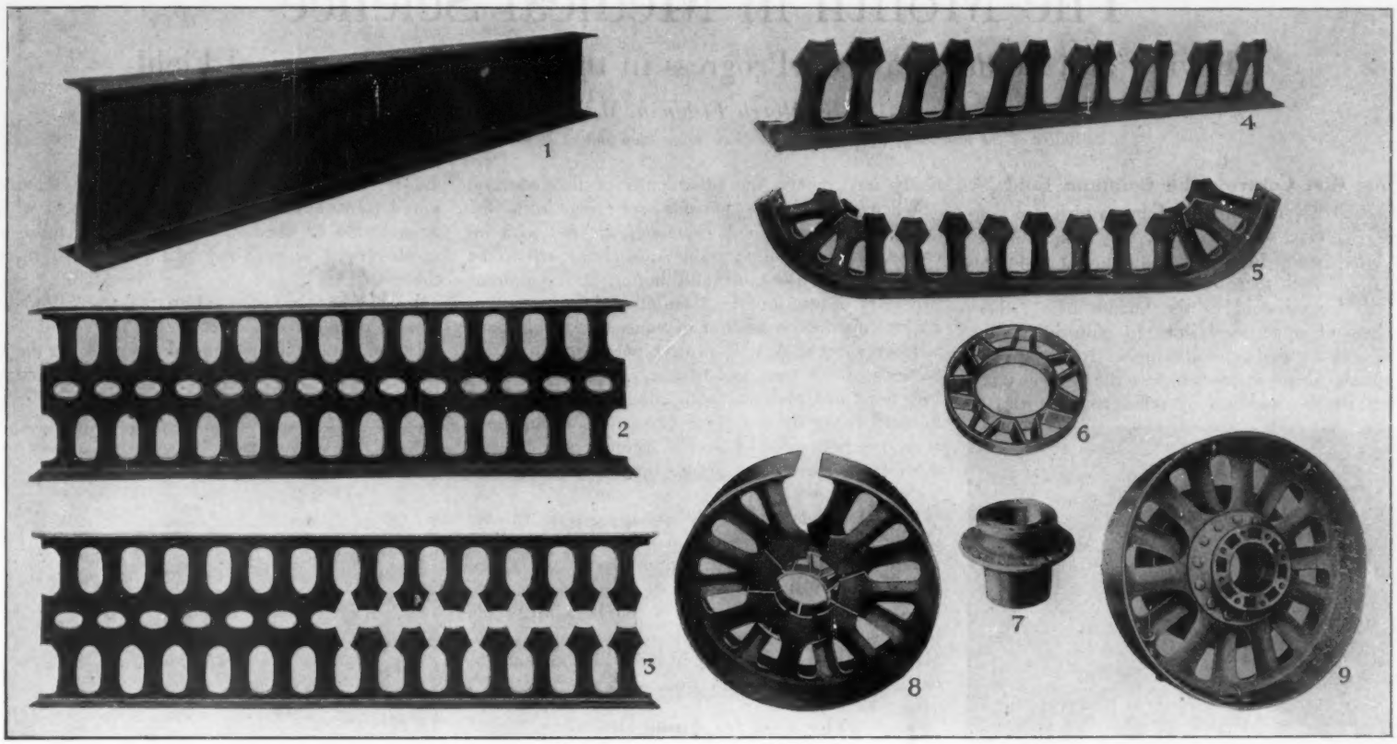
The animal had not died of old age. The size of the tusk and condition of the teeth would indicate an age of about 60 years. While digging we kept close watch for flint implements that might suggest that man had something to do with his fate. He might have been imprisoned in a crevasse in the glacial ice which occupied the country in those days. Or he might have died in battle with his rivals. But it is probable that the place where he met his fate was far distant from that of his burial. He had been carried by ice and flood waters, had been torn by fish or carnivorous mammals and dismembered before burial. The vertebrae were in a confused mass, a right hind femur near the head, the right tusk a fragment—a disordered remnant of a former giant. The place of burial was in a backwater behind a bluff 350 feet west of the present river channel, 33 feet above low-water level and ten feet from the surface of the ground. These deposits which filled the Ohio River valley in the late Pleistocene are water borne materials, hundreds of feet deep over thousands of square miles. They were laid down some twenty thousand years ago. And the mastodons, mammoths and other elephants of those days were buried and preserved here and there so that now a score or more have been found in Illinois and hundreds recorded in other parts of the United States.

The Elephants Were Cosmopolites

Elephants are great travelers. Starting in Africa they spread south to the Cape of Good Hope, north into Europe, east covering all Asia from the Malay Peninsula to Siberia; across to North America, spreading over the whole continent as far east as Labrador and Florida; south to Central America and finally to South America.

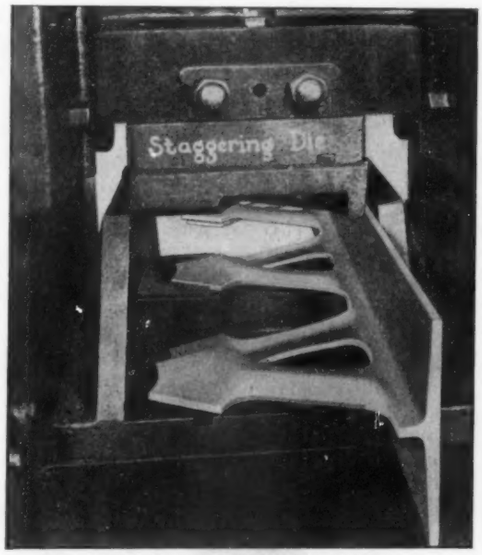
Hard indeed must have been the adverse conditions which exterminated them in North America. Today they are found only in Africa and India. The whole race is in danger of extermination in the not very distant future.

Caught in the asphalt pools of California, in Pleistocene times, a sabre-tooth tiger fought for his life. The story of this and of the finding of his skeleton will be told in a forthcoming issue.



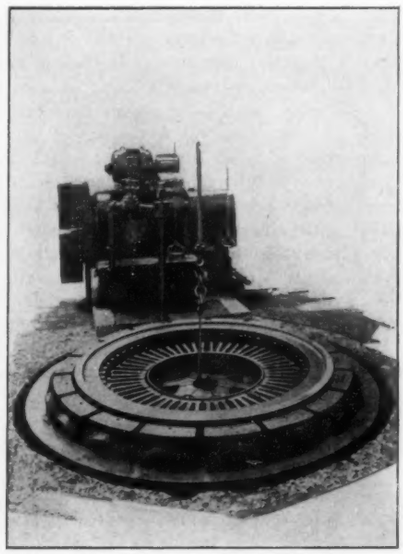
FROM I-BEAM TO TRUCK WHEEL

FIGURES 1, 2 and 3 *indicate the successive stages of punching the fabrication of annealed steel.* FIGURE 4 *shows the spokes staggered and edges rounded. In* FIGURE 5 *the ends are curved, ready for the final rounding.* FIGURE 6 *is the spoke spacer into which the hub,* FIGURE 7, *is riveted.* FIGURE 8 *is another step and* FIGURE 9 *is the finished wheel*



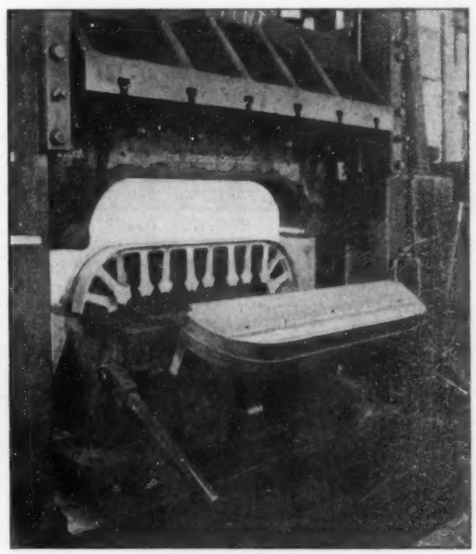
STAGGERING AND GROOVING

The spokes are so shaped that the ends will "keystone" at the hub when the beam is bent into its finished circular form



ROUNDING AND SIZING

An hydraulic setter assures the perfect conformation which standard tolerance demands



BENDING THE ENDS

In this large hydraulic press, the ends of the steel I-beam are bent through arcs of 90 degrees as in FIGURE 5 *above*

Pressed Steel Wheels From I-Beams

A novel method of producing steel truck wheels has been developed by the Bethlehem Steel Company and we are indebted to them for the photographs reproduced above. In the course of the process, during which a steel I-beam is converted into two steel wheels, large hydraulic presses are used. First, the special beam with an extra wide flange is punched in a press and openings are formed between the sections that will eventually be the spokes. A second punching operation separates the two halves of the beam which then each undergo the same processes in the transformation into steel wheels. The next press grooves and staggers the spokes, the ends of which are shaped so that they will "keystone" together at the hub in the finished wheel. Then the ends of the beam are turned through 90 degrees and finally the entire strip is bent to the form of a wheel. A small amount of material has been left on the ends and when the joint in the rim is "flash welded," this excess is burned off. The wheel is now placed in an hydraulic tire setter which sizes the tire and also trues the wheel to limits of plus 1/16 or minus 1/32 of an inch. In the next operation, the spoke ends are placed in contact with the spoke spacer. The wheel is trued from the outer diameter and bored, and the felloe is faced to width, all in one operation. The finishing operation includes the placing of the hub core brake drum and the bolting together of all parts. If required, chain hooks are riveted in place. These are for the purpose of holding chains when traversing deep mud or snow. They are shown in Figure 9 above.

The Month in Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.

Editor of the *Journal of the American Medical Association* and of *Hygeia*, the Health Magazine

How Diet Controls the Common Cold

WHEN rats are fed foods which are deficient in vitamin A, they gradually develop infections of the nose and throat. With these infections, as with the common cold in the human being, there come loss of appetite, failure to gain in weight, snuffles, and a running of the nose. In the case of the animals, death ensues, unless the diet is made adequate by the addition of sufficient quantities of

USING THE DOUBLE STETHOSCOPE

The tuning fork held on the patient's head provides a source of vibrations while the double stethoscope determines whether there is an infection of the sinuses

the proper vitamin. When the bacteria of the nasal secretions were studied, they were found to be similar to those which are found in the human nose and throat when a common cold is present.

Since vitamin A is found largely in butter fat, Dr. Amy Daniels of the University of Iowa School of Medicine endeavored to find out if there was any correlation between the butter-fat consumption and the prevalence of sinus infection in certain sections of the United States. It was found that the lowest per capita average of butter-fat consumption is that of Lewiston, Idaho, amounting to 19.7 grams, whereas Missoula, Montana, consumes 44.6 grams. Obviously, per capita averages are of little value in making serious conclusions in this matter, since some families may consume more and others less. The amount of butter-fat consumption in various families was therefore determined, and found to vary from 31.1 to 92 grams.

In Denmark and Sweden, a disease of the eye known as xerophthalmia is prevalent, and Blegvod showed that the disease is inversely proportional to the amount of milk, butter and cheese consumed in the diet. When the butter-fat consumption fell below 40 grams, there was a marked increase in the amount of xerophthalmia in the community. Few American families consume less than this amount of butter fat, which may account for the fact that this particular disease of the eye is relatively rare among the inhabitants of this country.

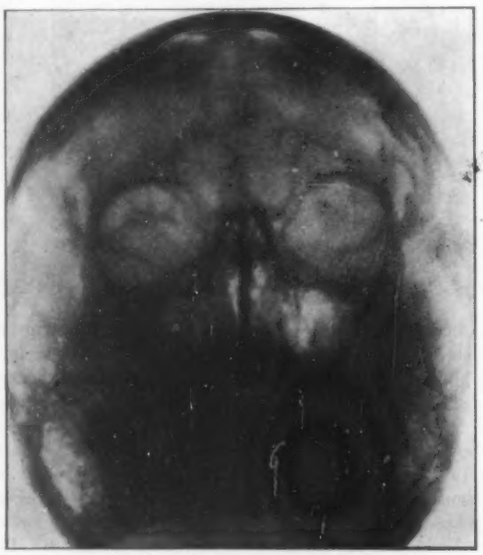
When animals or persons suffering with the symptoms of vitamin A deficiency are fed with increased amounts of vitamin A, such as are to be found in cod liver oil and butter, the symptoms promptly disappear. Dr. Daniels is convinced that an increase in the amount of consumption of foods rich in vitamin A will protect persons against infections of the nose and throat. If, however, these infections are present, foods alone will hardly influence them, since it is necessary that the acute condition be treated by proper medical methods and the infection overcome before bodily resistance can be raised.

One of the dangers of dietary discussions for the public is the assumption of some all-or-nothing policy in relation to the taking of food. It is well to remember that an adequate diet contains not only foods rich in vitamins, such as cod liver oil, green leaf vegetables, milk and the dairy products, but also proteins, sugars, fats and mineral salts, such as calcium, phosphorus and iron.

The Test for Sinus Disease

A DEVICE recently elaborated for the detection of sinus disease is a double stethoscope with a valve which deflects the sound from one side or the other into the ear pieces. The listener hears with both ears, but can hear only the sounds that come from the bell toward which the lever points. It has long been known that the detection of sound is better through solid substances, such as bone or a collection of fluid mixed with solid matter than through the air.

A sinus that is infected usually has thickened walls, or there is a collection of matter such as has been mentioned, whereas the normal sinus is clear and filled with air. In the test mentioned, the observer places the two bells of the stethoscope over the sinuses. A tuning fork is made to vibrate and placed on the head of the person tested. The listener then compares the sounds coming from the two sides by turning the switch alternately from one side to the other. The duration of the vibrations,



AN X RAY OF THE SINUSES

Even such pictures sometimes fail to reveal conditions that are made evident by the use of the double stethoscope

the intensity of the sound and other factors in sound transmission enable a decision as to whether or not one of the sinuses is affected more than another even when X-ray pictures fail to reveal a change.

In another instance, after the test showed the greater duration and intensity of the sound on one side, the X-ray picture showed thickness on the right side, and operation revealed that side filled with thick yellow pus.

REPLACING TORN TISSUE

When an oval-shaped piece of skin and fat was clipped from one of the fingers, the injury was repaired by growing on a piece of tissue from the palm

Plastic Surgery for Torn Fingers

WORKERS about modern machinery frequently suffer with clipping injuries that may remove whole portions of a finger, although only the skin and fat overlying the tendon are torn away. The plastic surgeon who attempts to cover a defect successfully finds it necessary to transfer tissue from other parts of the body, usually making a connection and permitting the new portion to grow into place before it is severed from its original location.

Dr. Gatewood of Chicago recently described a method of covering a defect in a finger while permitting the patient to continue at his work. A Mexican had his finger caught between two iron rails, pinching out an oval shaped piece of skin and underlying tissue. The tissues were made devoid of sensitivity by the injection of a local anesthetic. Then the finger was connected with the thick portion of the palm, and after this had been opened, set in position. When the new flap grew over the defect in the finger, it was severed from its original site. On account of looseness of the tissue in the palm, it was only necessary to sew up the hole thus left, and the patient again had a working hand.

Aluminum in Cancer

A DENTIST of Toledo, Ohio, for what reason it is not apparent, has issued a pamphlet of 36 pages,

presumably sold for one dollar, although sent free to libraries, school teachers and hardware stores. On the basis of some naive and totally immaterial experiments, he says that the use of aluminum cooking utensils increases the incidence of cancer. The proverb *post hoc ergo propter hoc* is here revealed to its highest extent. It is claimed that the use of aluminum has increased at the same time that cancer has increased; therefore, the latter is due to the former. It might equally well be said that automobiles are responsible for cancer or that bobbed hair or any of the other things that have increased during the past 25 years share this responsibility. The reasoning is a typical example of the way medical statistics are misinterpreted by those who know nothing of biometry.

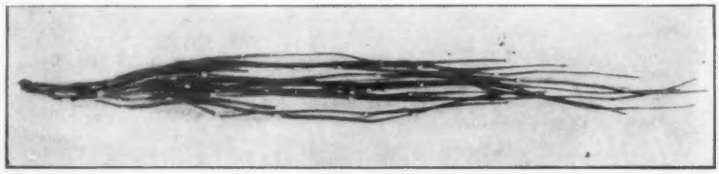
It is not at all certain that there has been an alarming increase in cancer, since cancer is a disease of advanced age and more persons are now living longer than used to reach middle age. Life expectancy has advanced in the past century from 35 to 55 years. Investigations in Great Britain by workers under the auspices of the Medical Research Council showed that the cooking even of acid fruits and vegetables for long periods of time resulted only in the slightest traces of aluminum in the juice when the process was completed. It is known that alkaline substances, such as sodium carbonate or bicarbonate will eat away aluminum, but these substances do not enter into cooking processes.

The theory of the Toledo dentist is pernicious in that it is used to disseminate false advice concerning cancer and to attack the use of a well established household utility.

Ma Huang or Ephedrine

FOR more than 5,000 years, Chinese medicine has used a drug known as ma huang. The Emperor Shen Nung tested the use of the remedy about 3200 B. C. Chinese physicians prescribe it to produce sweating, to lower fever, or to stimulate the circulation. The plant, as shown in the accompanying illustration, is a practically leafless shrub which is found in many Chinese provinces, but which may grow also in central Europe.

As pointed out by Drs. K. K. Chen, of the University of Wisconsin and Carl F. Schmidt of Philadelphia, the active alkaloidal principle of this shrub was isolated in 1885 by a Japanese physician, named Yamanashi. He called it ephedrine. Little was done with the product, however, until Chen reisolated the substance and reported his studies of it in 1923 and 1924. American physicians are now beginning to give special consideration to the properties of this new drug, since some of these properties make it exceedingly valuable in medical practice.



MA HUANG

This practically leafless shrub finds many applications in the practice of medicine, particularly in the treatment of asthma and enlargement of certain parts of the nose

Actually the drug resembles chemically another product with a similar name, epinephrine, better known under the commercial name of adrenalin. Like epinephrine, it has a depressant action on muscle tissue, such as that of the heart, and produces a rather lasting rise of blood pressure when injected into the body, due mainly to the fact that it constricts the blood vessels. It also serves, when taken into the nose, to reduce swelling of the mucous membrane to which it is applied. Therefore, it has been used in much the same manner as epinephrine in asthma and for shrinking the turbinated bodies in the nose when they are enlarged.

One of the chief values of the product lies in the fact that it may be made up into solutions which will keep for a longer period of time than will solutions of epinephrine. The latter are known to be somewhat unstable. Ephedrine is also less poisonous than epinephrine. The latter is a stronger stimulant, as might be expected from its toxicity, and it has even been suggested that the ephedrine may be used with the epinephrine, the latter securing a prompt effect, and the former prolonging it.

Pasteurized Milk

THE best milk for an infant is that which it obtains at the mother's breast. When this fails for some of the many reasons which seem to obtain, it is necessary to provide a substitute. Specialists in the diseases of children have found that cow's milk is for most purposes the best substitute. For a time it was thought that goat's milk had superior advantages, particularly because of the alleged lessened susceptibility of the goat to tuberculosis. However, every civilized community nowadays gets its milk from cows that have been tuberculin-tested, and the milk is usually pasteurized before it is delivered. Cow's milk has the disadvantage of slower and less complete digestion because it is likely to form tough curds in the infant's stomach. Therefore, specialists in the diseases of children modify the cow's milk by boiling or by adding various substances to it to prevent the formation of the hard curds that have been mentioned.

Dr. Julius H. Hess and his colleagues at the University of Illinois College of Medicine made a comparative study of milk pasteurized at a low temperature for 30 minutes, milk boiled five minutes, raw fresh milk and milk that had been modified by the addition of various forms of acids, including lemon juice, tomato and orange juice. It was found that raw pasteurized milk forms large curds, while boiled and acidified milk forms very small curds. It was also found from experiments on puppies to which the various milk modifications were fed that milk acidified with cultures of lactic acid is superior to other forms of acidified milk, but that orange juice gives the highest amount of total soluble protein, an important body supplying constituent of the diet. Orange and lemon juices have the added advantages of containing vitamins, mineral salts and additional factors.

The Chicago pediatricians recommend that orange juice in a quantity of two ounces to a quart of milk forms the best mixture for infants, lessening the amount of fruit juice when less than one quart of milk is used. The milk should be stirred thoroughly while the fruit juice is added. They also recommend the addition of the yolk of raw eggs, beginning with one-fourth of a yolk at four weeks of age and increasing to a whole yolk by the fourth month in order to supply iron and the fat-soluble vitamin which is not supplied by the milk and orange juice mixture.

Preventing Fatigue

SOME years ago, the world was startled by the claim that a German investigator named Embden had found that fatigue in workers could be prevented by giving them a drink containing acid sodium phosphate in small doses. In large doses this substance acts as a laxative. The German investigator claimed that workmen who received as much as 75 grains of this salt on mornings of days of hard exertion were less fatigued and capable of doing more work than men who received an acid drink without phosphoric acid.

It has been believed for years that hard work puts a great demand on the phosphorus of the body which calls for abundant replacement. The United States Public Health Service, after a thorough investigation, has stated that the claims of the German investigator are not warranted by facts. They are inclined to ascribe any value following the administration of the drug to the fact that even in the doses given it acted as a laxative. The relief of chronic constipation from which so many persons suffer makes them feel better and therefore enables them to do more work; in other words, the acid drug could not be credited with the specific effect of controlling the fatigue.

OIL CAN FOR FIGHTING MOSQUITOES

The weighted bottom of the conical can causes it to sink when placed in a mosquito-infested pond. The oil then seeps out through the opening, being replaced, in the can, by water. The complete use of this can is explained below

The matter is especially important as it is understood that a syndicate of American business men will attempt to exploit a proprietary drug that is essentially acid sodium phosphate, but with a fancy name.

A New Way of Oiling Ponds

THE breeding of mosquitoes is controlled nowadays by the use of oils in ponds, marshes or swamps which prevents the development of the mosquito in its early stages. Major William O. Wetmore, Medical Corps of the United States Army, stationed in Hawaii, has devised a conical can with a diaphragm near the bottom containing two chambers. The lower one contains sand which acts as a weight and the upper chamber contains oil. Both are equipped with a cap for filling. Along the outside lies a tube with an inlet at the top and an opening into the oil chamber at the bottom. The apex of the chamber has a wire wick which permits the oil to escape in droplets. The can is tossed into a pond and the weight sinks it. Oil begins to escape from the apex while water is turned into the lower portion of the oil chamber, displacing the oil which floats to the surface and there prevents the further propogation of mosquitoes.

A five gallon can, according to experiments made in Hawaii, kept a pond the size of a city block oiled for a month. It is of course possible to deliver oil in these containers which can be constructed at a reasonable cost. A patent covering this device has been applied for.

Why Is a Balloon Tire Efficient?

Certain Characteristics of Vulcanized Rubber Make This Type of Automobile Tire Run Cooler and Therefore Last Longer

By D. H. Killefer

Associate Editor, *Industrial and Engineering Chemistry*

WHAT tires a tire? In spite of its apparent similarity to the noise that annoys an oyster, this question is a real poser and not a mere punster's invention to fill gaps in polite conversation. It cost a great deal of time and money to find out that heat tires tires and that only tires as cool as proverbial cucumbers really last. It is by their resemblance to that vegetable, however much more they may appear to be like doughnuts, that balloon tires are really practicable and thereby hangs this tale.

One must go back to Charles Goodyear's first vulcanized rubber in 1839 to begin the story that has just reached a climax in "cool" tires such as we have today. Goodyear was interested in making rubber that would be elastic whether it was hot or cold instead of sticky or brittle as it was naturally in summer or winter. Partly by design, but probably more through a very lucky accident, he hit upon the valuable combination of rubber, sulphur and heat, and by varying the proportions of these three he could make anything from hard rubber to rubber bands, after a fashion. The fashion, he found, was improved if some other things were added, but in general these other things were not considered very important and nothing much was done to improve this mixture of Goodyear's until "the Twentieth Century rolled in on the wheels of the infant motor industry." As a matter of fact, no one cared very much how tired rubber became so long as the only uses for it were easy jobs that even weary rubber could handle easily.

Then, too, the automobile with its early call for quantities of pneumatic tires that would stand the hard service of horse and buggy roads made it necessary for the tire makers to use low grades of rubber to eke out the limited supply of para, from South America, that had formerly sufficed. No one had yet conceived the idea of deliberately growing rubber as one might grow peaches or corn, and so everything that the natives of the jungles thought was enough like the sap of *hevea brasiliensis* to pass muster at the collecting stations ultimately found its way into the hazardous business of early automobiling. Perhaps that is not quite a fair statement, but it is very nearly so, for if the miscellaneous junk collected in the forests did not go into tires it certainly went into something else and released that much more good para for the tire makers. The element of suspense introduced into the rubber compounder's life by dissimilarities and unaccountabilities of the crimes committed in, and branded with, rubber's name properly begins this story of the relief of rubber's fatigue.

Why Tires Wear Out

It often happens that tires, especially those of the cheaper grades, have to be discarded long before they have delivered their full mileage. Just why this should be the fact is not well known to the average automobile driver, who is prone to think the only thing that wears out a tire is the actual contact between the tread and the road surface. This is not the case, as Mr. Killefer explains in the accompanying article.

When traveling over the surface, the tire bends or "gives," due both to the weight of the car and obstructions encountered. This causes heat to be generated within the tire and if the heat is great, the tire will deteriorate rapidly. Solving the problem of reducing the heat has added to tire life. ***—The Editor.***

In 1905 a paper chemist by the name of Oenslager decided that civilization had much to offer to a young man as compared with the rough and ready existence of a paper-mill village on the edge of the forest. A friend of his was in the rubber business and thither he hied, much to the benefit and profit of all concerned. The particular rubber business he entered was beset, as were all others at the time, by the ever-pressing problem of curing a number of varieties of wild rubber that were essentially different in their behavior, and upon these he set carefully to work.

His first efforts were directed toward finding a way to make these various wild rubbers come out of the vulcanizers as quickly and as satisfactorily as first grade para. In the vulcanizers, the rubber mixture containing sulphur is subject to heat and that heating is very similar, we may imagine, to the training of an athlete. If just the right amount is applied, the finished article is in fine trim for its purpose, strong, pliable, elastic and full of what might be considered "tenth-round comeback." If it is underdone or overdone, the product is as flabby and weak or stiff and uncertain as an over-trained fighter. Not only was it possible to do too much or too little in the vulcanizing process but several things, oleic acid, zinc oxide and so on, could be added to the rubber dough which would shorten the heating process perceptibly without leaving the stuff underdone. The trouble with most of the wild rubbers was that they required too much heating to bring them to the right point and then they were already beginning to slide over onto the old-age side of the line.

Oenslager looked into these speeders-up and conceived the idea that something else might be a great deal better and that if he found it, the soft Corinto, Esmerald and Mexican rubbers might be made as satisfactory as para. That was something to work for, and one after the other everything available was tried out. Until aniline, the stuff for which aniline dyes were named, was tried, nothing did very much good, but after that it was found that not only aniline but everything remotely related to it by ties of chemical "blood or marriage" made the vulcanization much faster and more satisfactory generally. Some of the members of the aniline

Photograph courtesy Firestone Tire and Rubber Company

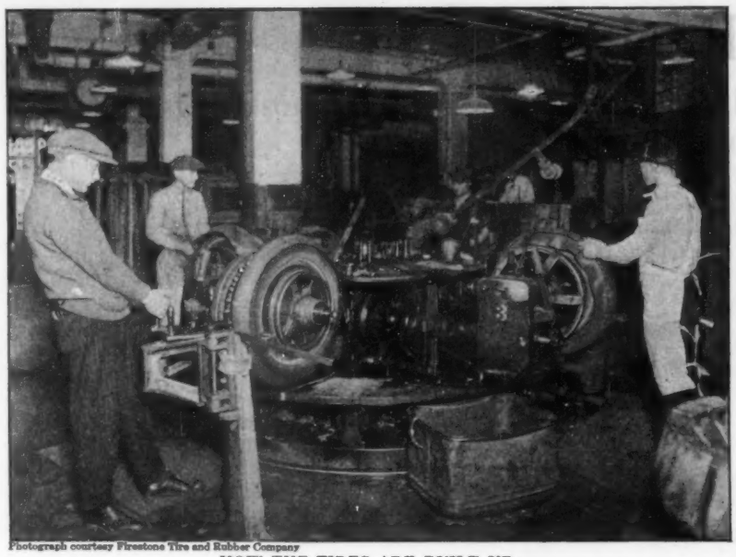
WHERE THE CRUDE RUBBER IS WASHED

In these machines, the crude rubber is thoroughly masticated between two revolving rolls while it is exposed to the thorough washing action of water

Photograph courtesy Goodyear Tire and Rubber Company

CHECKING THE WEIGHTS OF THE MATERIALS

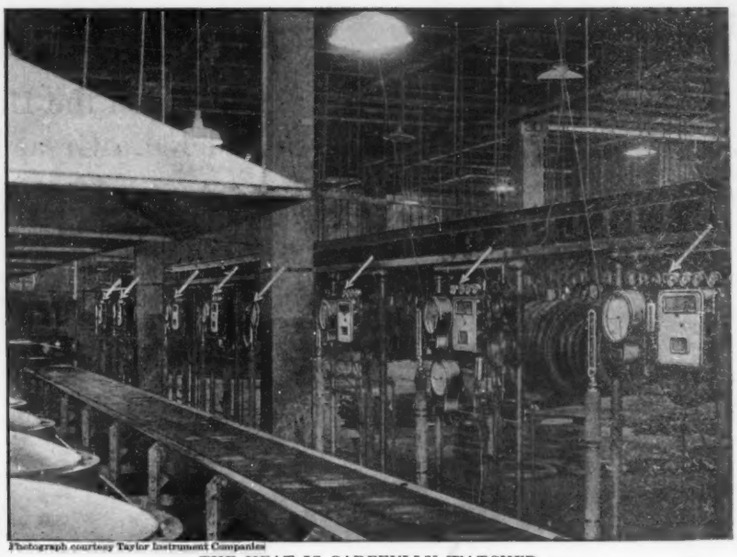
The materials are collected and placed in iron baskets. They are conducted, on an endless conveyor, to the scale shown and then to the mixing room



Photograph courtesy Firestone Tire and Rubber Company

HOW THE TIRES ARE BUILT UP

Each layer of fabric is stretched tightly in position and pressed firmly in place. With the revolving table shown, the entire process is quickly completed



Photograph courtesy Taylor Instrument Companies

THE HEAT IS CAREFULLY WATCHED

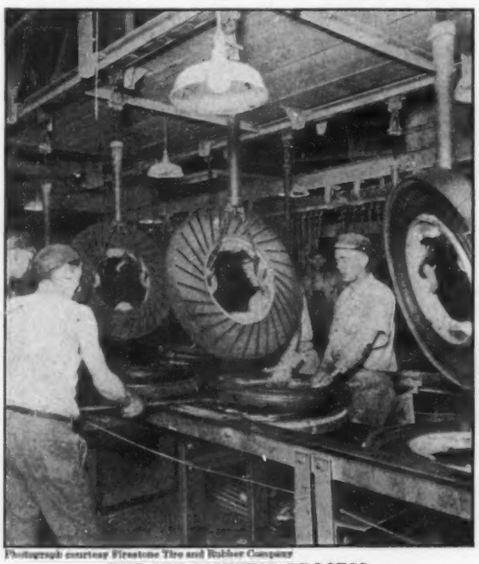
The various heat registering and recording instruments, indicated by the arrows, keep a rigid check on the vulcanizing temperature of each individual tire

family—the family's name is properly organic nitrogenous bases—along with other things made it possible to do as much toward vulcanization in a few minutes as would otherwise have required a matter of hours, and in that way the debilitating effect of too long a training period was avoided.

Exactly why such a thing should happen is still unknown, just as we have no really definite ideas as to what rubber itself is or why sulphur makes it usable. Those things are still problems, but the facts remain and continue to be profitably useful. As time has gone on, many investigators have looked into this matter of vulcanization accelerators and many new ones, of far greater value today than the original ones, have been found and put to work. The whole tendency of rubber compounding has been toward shorter and shorter time of vulcanization and the value of this has been almost incalculable.

In spite of the ideas recently advanced by certain physicists that there is something wrong with the old law of the indestructibility of energy and the impossibility of perpetual motion it must now be introduced into this discussion. A considerable part of the energy put out by an automobile engine is absorbed in the bending of the rubber of the tires as the car moves along. Some of this absorbed energy is given back as they unbend, but the rest is dissipated as heat by the friction of the particles of the rubber upon each other in the process. This heat is released just at the wrong place, for it has difficulty in getting out to the air and in the meantime it is engaged in overtraining the rubber as fast as it can.

No one knows precisely why rubber grows old, but we know a number of things that assist the process and heat is one of them. Oxygen has a great deal to do with the aging process but the action of the latter is much hastened by heating. The vulcanization process itself can be accomplished either by a high temperature for a short time or by a lower one for a longer time, so that it is not too far from the actual fact to imagine that this internal heating gradually overcures the rubber. It is even possible to weaken rubber before it is vulcanized by working it too long and too hard on the kneading rolls, perhaps due to the heat there developed. So it is not unreasonable to presume that this kind of uncontrolled over-vulcanization in the tire itself has something to do with its earlier demise. The thing is progressive, too, for the more the overcure, the more the friction, the more the internal heating, the more the overcure, and we have the house that Jack built going in a vicious circle that no self respecting tire should tolerate.



Photograph courtesy Firestone Tire and Rubber Company

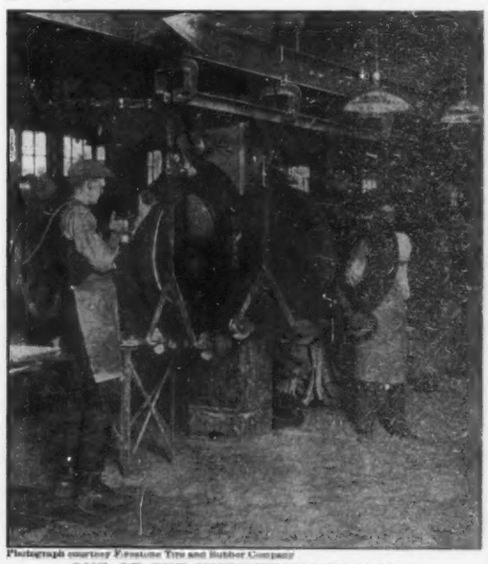
THE VULCANIZING PROCESS

The built-up but uncured tires are placed in the moulds shown and submitted to a complete curing process

Its Coolness Is the Answer

When rubber began to be grown on huge plantations in the tropics, it was no longer necessary to worry about the wild miscellany that started Oenslager's investigations, but the value of his findings has grown immensely in the meantime. One of the things accelerators do, in addition to making the same set of vulcanizers able to turn out work several times faster than before, is to shorten the exposure of the rubber compound to heat and thus get it onto the automobile wheel still young. One does not ordinarily think of tires as being young or old, but the fact is that rubber "lives," if you will, many times as fast in the vulcanizers as on the shelf. One may even think of a tire as burning its candle at both ends during the time when rubber and sulphur are being made to combine, and only at one end feebly when in use. If it were possible to carry out vulcanization in a second at ordinary temperatures without having it go on and on afterward, the thing would be nearly ideal. But that is impossible with tires at present. However, the accelerators of vulcanization have contributed this to the rubber industry: they have made it possible to cure rubber at a lower temperature for a shorter time and thus the burning of the candle at both ends has been greatly shortened.

Balloon tires bend much more deeply in service than ordinary hard, high-pressure tires and thus they absorb much more energy. If the proportion of this energy turned into heat by internal friction were not very small, the life of the tire would be altogether too short for economy, but by reducing the figurative age of the rubber itself by speeding up vulcanization and by using as filler only those materials which themselves have low coefficients of friction and do not add materially to the internal heating, the whole thing is made economically possible. In other words, it is the balloon tire's constitutional coolness that makes it possible at all. Of course, the design of the tire, the strength of the textile base, and a number of other things have contributed to make the automobile ride more comfortable, but a paper chemist who wanted to return to civilization took most of the weariness out of tires. Tires congenitally cool and almost tireless now wear themselves threadbare on the roads before they give up.



Photograph courtesy Firestone Tire and Rubber Company

ONE OF THE INSPECTION PROCESSES

During each of the steps of manufacture, the tires are inspected to insure absolute uniformity

A Trip to Boobyland

Some Interesting Sidelights on the Habits of the Booby, a Bird Whose Eggs Are Considered a Great Delicacy by Many People

"WHY what is this, Captain? Is it really snowing in the middle of May, and here in this tropical climate, too? Here, look through your glasses at the little island yonder—the air is literally filled with heavy snowflakes, and there are dots of snow all over the faces of the cliffs! What can it mean?"

The captain of the boat did not need to look through his glasses, however; he knew what the strange phenomenon was.

"The joke is on you, my friend. I take it you have never passed this island before, or you would know what that "snowstorm" really is. No, it is not snow—far from it. That is Boobyland over there, and those are the booby birds which give it its name. I will be stopping there on my return trip in June for a shipment of booby eggs, and if you happen to be coming back at that time, you can get a closer view of the place. If you will look through your glasses again, you will notice that the natives are out in their boats. The booby birds help them in their fishing operations a great deal, for they feed on fish, herrings particularly, and as soon as the shoals of fish approach the coast, they assemble in flocks and indicate to the fishermen the presence and position of the fish."

Birds Average Three Feet in Length

The captain of the ship was right. Boobyland is a little island off the mainland of Jamaica, British West Indies, and it is literally covered with the booby birds, as the accompanying photographs show. They are more usually called "gannets" and sometimes, "solan-geese." The name "gannet" comes from the old English word "gan" which means "gander" or "goose" and the name "solan-goose" comes from the Scandinavian which means "Sea-goose." The term "booby," however, is applied because of the simple, foolish appearance of the birds, especially when they are on land.

The boobies are rather large birds, averaging approximately three feet in length. They have long, pointed wings, and long, sharp tails. The plumage is white except the wings and tail. The bill is stout and sharply pointed and the nostrils are completely closed. The reason for the closed nostrils is attributed to the manner in which the birds secure their food. They capture the fish by plunging down upon them from a height of about 40 feet. They dive with half-closed wings, like great spearheads, with such a force that the water is splashed for ten feet or more into the air. They do not have a throat pouch as some birds do, but they are able to greatly dilate their throat, and this allows them to swallow fish of considerable size which they can disgorge at will to feed to their young.

The family *sulidoe* to which the booby bird belongs, is a very old one, as fossil remains have indicated. There are some four or five of its species found along the North American coasts, but one of the most celebrated of its nesting places is the Bass Rock at the entrance of the Firth of Forth, Scotland. Mr. Charles Dixon, in a very graphic account of a visit to this spot, says:

CLOSE-UP OF A BOOBY BIRD
A large, swimming bird, also known as a "gannet"

"Upon reaching the Bass, a few gannets may be seen sailing dreamily about, but you have no idea of the immense numbers until you have climbed the rugged hill. But when the summit of the cliff is reached, the scene that bursts upon one's gaze is one that well-nigh baffles all description. Thousands upon thousands of gannets fill the air, just like heavy snowflakes, and on every side their loud, harsh cries of "carra-carra-carra" echo and re-echo among the rocks. The gannets took very little notice of our approach, many birds allowing themselves to be actually pushed from their nests. Others utter harsh notes, and with flapping wings offer some show of resistance, only taking wing when absolutely compelled to do so, and disgorging one or two half-digested fish as they fall lightly over the cliffs into the air. On all sides facing the sea, gannets may be seen. Some are standing on the short grass on the edge of the cliffs, fast asleep, with their heads buried under their dorsal plumage; others are preening their feathers; while many are quarreling and fighting over standing-room on the rocks."

Borreag, an island a few miles from St. Kilda, is also another great breeding place. Mr. Dixon says of this place:

Colony May Be Seen 40 Miles Away

"The flat, sloping top of one of these stupendous ocean rocks looks white as the driven snow, so thickly do the gannets cluster there, and the sides are just as densely populated wherever the cliff is rugged and broken. So vast is this colony of birds that it may be seen distinctly forty miles away, looking like some huge vessel under full sail heading to windward."

These two places are insignificant, however, as compared with the Bird Rocks in the Gulf of St. Lawrence as they were about fifty years ago. It was estimated that one hundred and fifty thousand of the birds were nesting there at that time, but these have all been killed in the last few years.

Boobyland, however, still has its birds. They deposit their eggs, which are two in number, on the bare sand or rock. This nesting time occurs in June or early July and so once each year the natives collect the eggs by the thousands and ship them to market at Kingston, Jamaica. They are considered a great delicacy.

In spite of all the eggs that are gathered and shipped, the birds are still abundant. Just imagine, if you can, what the island would look like in a few years, if all the eggs in the illustration and that many more each year were hatched into booby birds!

A SHIPMENT OF BOOBY-BIRD EGGS
These eggs were collected in Boobyland and are being shipped to Jamaica, British West Indies, where they are highly prized as food

ON THE ISLAND CALLED BOOBYLAND
Here great numbers of the booby bird congregate and lay their eggs. They often are so numerous as to give the appearance of falling snow

THE APPEARANCE OF TRUCKS IS IMPROVING

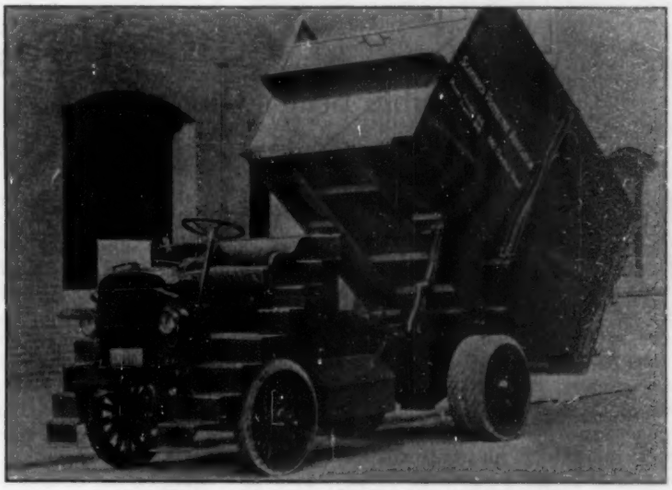
The photograph above shows how truck bodies are assuming the symmetrical lines of the pleasure car. Note how the head-lights are built into the radiator shell

SAFETY AND SPEED ARE IMPORTANT FACTORS

This truck combines the safety of four-wheel brakes with the capability to stand continued high-speed operation. This type is now going into production

SHORT WHEELBASE IMPROVES TRAFFIC CONDITIONS

With the advent of the 97-inch wheelbase truck, congestion, due to parking with the rear wheels at the curb while unloading, has been greatly relieved



A NEW TYPE OF GARBAGE TRUCK NOW IN USE

This is one of a large fleet used by the city of San Francisco. The all-metal construction and the steps leading to the top of the body are notable features

Motor Trucks Are Aiding Rapid Industrial Transportation

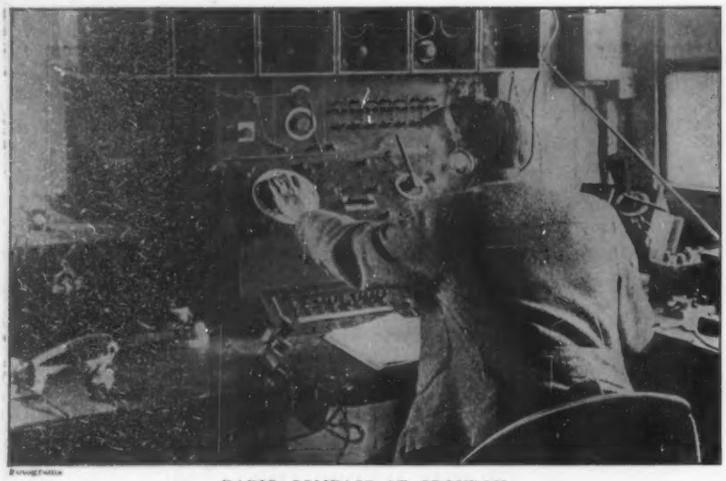
The motor truck of industry is beginning to specialize in certain kinds of work, rather than to compete with railroads. This increasing specialization is now showing its effect on the truck's construction, or, in the language of the biologists, the truck is adapting itself to its environment. Consider one or two of the salient facts about general field trucking today. Registrations last year showed 2,441,709 trucks in the United States, and the new production this year will amount to about 500,000. Thirty-seven railroads use them for terminal movements of shipping, ten railroads use them to replace local freight trains, and ten use them for store-door delivery. Great organizations like the American Express Company have fleets of over 5,000 of their own trucks. The Post Office Department runs 5,300. In the state of Connecticut a check of truck traffic showed a movement by truck of 3,540,000 tons of goods in one year. No national figures on this can be had, but one can safely deduce that since Connecticut's truck registration is one-sixtieth of the total American registration, the total movement of goods by truck must be annually in the neighborhood of 200,000,000 tons.

Let it be said here that leading authorities in the world of trucks do not believe that the truck is destined to supplant the railroad. They do believe, however, that it will do much of the short haul work of the railroads, and that it will probably do much of this under railroad operation. The Lehigh Railroad, in January, 1926, found that trucks handling freight between Elmira and Ithaca, New York, achieved a net saving of $220.27 for the month; between Sayre, Waverly and Wysox they made a saving of $2,429.04.

Today, no effort is being made by manufacturers to make heavier trucks, capable of greater loads. The highways could not stand it even if the trucks could. Fifteen-ton trucks are made, but the National Automobile Chamber of Commerce has no classification for more than five tons. Seventy percent of the last year's production was in one-ton models, and this is the direction in which manufacturers are working more and more. In 1919, the percentage of one-ton models produced was 47; in 1920, the percentage was 51; in 1921, 54; in 1922, 58, and in 1923, 70.

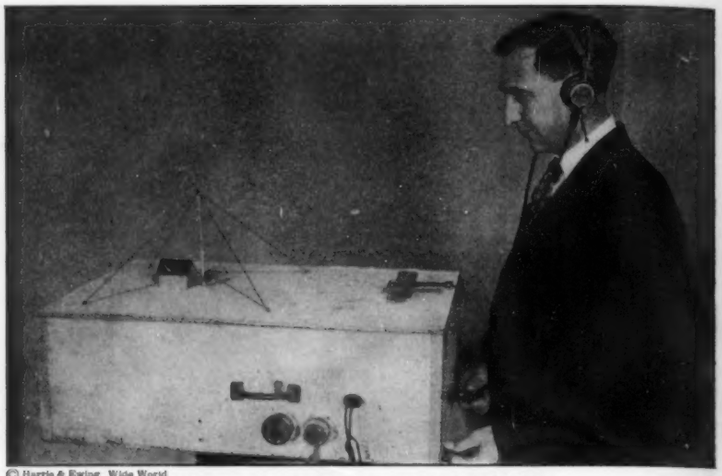
The first light motor vehicles designed to carry a comparatively light commercial load at something approaching automobile speed were a direct offshoot from the automobile itself, and were not really part of the evolution of the motor truck. These light delivery vehicles were essentially of pleasure-car design. New productions, however, have the sturdy stamina of the real motor truck and in addition the flexibility, the speed, the comfort and the beauty of the automobile. Modern trucks are equipped with four-wheel brakes, springs are made with new care, and the bodies are so slung as to do away with the rough old days when nobody cared how badly a truck bumped along, to the detriment of its cargo.

With these improvements, manufacturers are keeping a keen eye on short wheelbases. One manufacturer, in fact, producing a two-ton truck with a 97-inch wheelbase, has figured out that this carrier, because of its flexibility, saves 20 minutes a day, which is equivalent to more than two weeks a year, giving such a model a "54-week year" of profitable "truck hours." It would of course be folly to suggest that because faster and more flexible trucks are being developed, production of the big, heavy models have been neglected. The accurate statement of the situation is that great emphasis is being laid today on the fast, small delivery trucks.



RADIO COMPASS AT CROYDON

To locate the direction of an airplane, the operator of the radio compass turns the dial as shown until the signal is at maximum volume



© Harris & Ewing Wide World

MODEL RADIO BEACON FOR AIRSHIPS

Francis W. Dunmore, of the radio laboratory of the Bureau of Standards, operating a model of a double-beam beacon designed to guide aviators

Radio Along the Airways

Invisible Beams Guide Birdmen in Flights Between European Cities

By Orrin E. Dunlap, Jr.

AMONG the interesting stories told by several American tourists upon their return from Europe, was a narrative of being lost in the clouds while flying across the English Channel. They hopped off early in the morning. The sky was overcast and as the plane soared westward it ran into thick weather. They were aware of the length of time usually required to wing their way from France to England and according to their watches the plane was overdue an hour. After apparently groping aimlessly in the fog, suddenly the pilot seemed to sense his position in the sky, as if he had caught a glimpse of some landmark, but the passengers knew that this was impossible in such a blanket of fog. The speed of the machine increased and it seemed to be flying in a straight line for a definite destination. Soon the plane dipped below the curtain of fog and came to earth without a mishap. As the passengers disembarked, one of them asked the airman if he was lost at any time during the flight. He said, "Yes, until I called up Croydon and obtained our position."

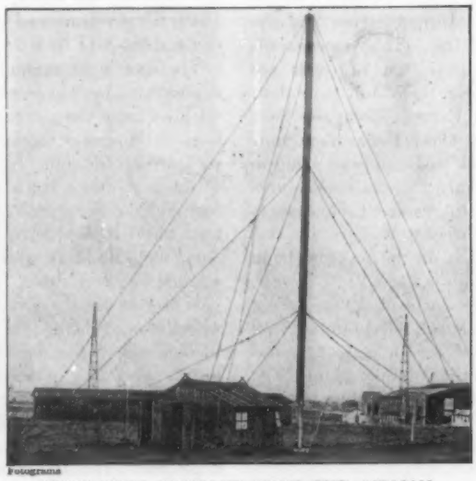
Effective Over a Range of 100 Miles

There are a large number of radio compass stations scattered along the ground beneath the airlines of England, Belgium, France and Germany, so that an airplane equipped with radio can quickly obtain a position report before the navigator has a chance to go far astray. For example, the pilot calls Croydon and the operator there notifies the radio man at Pulham, in conjunction with whom he works, to listen. The flyer talks for half a minute while the ground operators tune in without paying much attention to the conversation. As long as some sound can be heard the compass operators can take bearings. The results obtained at Croydon and Pulham are compared over a telephone line which joins the two stations. Then the Croydon operator charts the bearings on a map and thus determines the airship's exact position, which he flashes to the aviator.

A compass operator describes the work of locating an airplane concealed in the fog as follows: "It is just as if two persons were listening for a mouse in the wainscoting from different corners of a room. The squeaking of the mouse would come to their ears from the same point along two different lines and by following through to the point where the lines meet, they will locate the rodent."

The radio direction finders operate in a manner similar to a loop antenna; when the plane of the loop points toward a transmitter, the signal is loudest and the operator knows that the station is located somewhere in the direction in which the loop points. Reports from England say that the radio system is quite accurate in finding airplanes within an area of 100 miles, over which distance the error is said to be rarely more than half a mile.

Thus it can be understood that radio is an important adjunct to aerial navigation and a vital factor in the development of commercial aviation. England, France and Germany are developing their commercial air services, with radio playing an important part in the safety and convenience of passengers. Germany has been called the "turnstile of Europe's air traffic." Only recently the German Air Service announced that the planes will be equipped with radio telephones to enable travelers in the sky to talk with telephone subscribers in any large German city in the same manner that passengers on the trains running between Berlin and Hamburg can communicate with their homes, or offices, by a combination of radio and land-wire service. It is planned that the radiophone will be placed first at the disposal of passengers on the routes between Paris-Berlin, Berlin-Stockholm and Berlin-Konigsberg.



ENGLAND'S CONTACT WITH THE AIRMAN

The out-door equipment at Croydon Airdrome, from which signals are sent to the cross-Channel planes

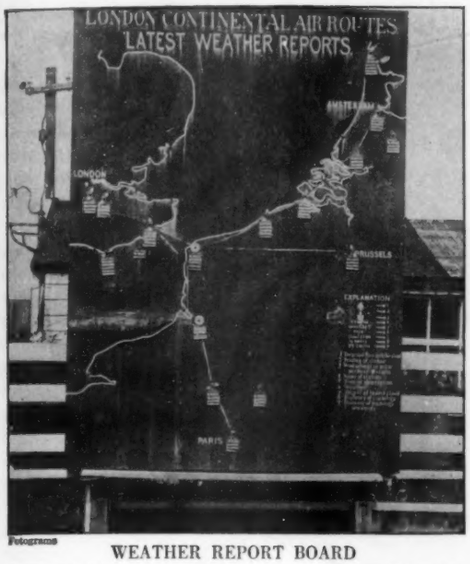
Germany's aviation statistics reveal the large field in which radio is destined to perform a valuable service in communication and direction finding. In 1925, German planes are reported to have flown 3,000,000 miles in regular service; 85,000 passengers were carried and 1,000,000 pounds of freight were transported through the air. It is expected that the figures of 1926 will greatly exceed the record of the previous year. The German air routes now total more than 12,000 miles. A train takes 22 hours to run from Paris to Berlin and the fare is 35 dollars. An airplane makes the trip in eight hours and the fare is 45 dollars. Travelers on the European airlines find that there are express planes, excursions, inter-urban and sightseeing aircraft equipped with club chairs and kitchenettes for serving refreshments.

Minimizes the Danger from Fogs

Dr. Edmund Rumpler, inventor of the Taube type machine, predicts that airplanes propelled by ten motors of 1,000 horsepower each, and capable of traveling 175 miles an hour will be flying between Hamburg and New York ere long. It is expected that radio will enable the transatlantic passengers to communicate with friends on land throughout the voyage.

More than 1,000 travelers make the trip in the air liners of the Imperial Airways, Ltd., between London and Paris, weekly. The actual flying time between the airdromes at Croydon and LeBourget is three hours and the journey from the heart of London to the center of Paris is about five hours. This new route of travel between the Continent and Britain began in 1919, when war machines were converted to commercial use, but at that time they carried only the pilot and two passengers. Today the air liners have comfortable cabin accommodations for 26 people and lunch is served *en route*.

At first the planes were equipped with wireless



WEATHER REPORT BOARD

Detailed information regarding the weather conditions between London and Paris are received by radio and posted on bulletin boards located at the various airports

for communication with other fliers and land stations, but now the Hertzian waves perform three main services. First, messages are sent between the airports as notification of arrival and departure, number of passengers and amount of freight on board, just as a passenger steamer on the Great Lakes sends similar messages after clearing Buffalo for Duluth. Radio's second duty is to enable the pilot to talk with other aircraft and land stations. The third use is direction finding. In 1919 flights were frequently canceled because of fog, one of the greatest barriers to cross-channel flying, but today radio direction finders are credited with having increased the trip efficiency to 90 percent.

To improve the service, experiments are now being conducted with a direction finder installed on the planes so that the pilots can ascertain their own positions by taking bearings on the land stations instead of calling a ground station to furnish the bearings.

It is now hoped that a regular night service can be established between London and Paris. On clear nights there is little difficulty in making the trip, because the navigator can guide the plane by lights shot up from the airports and from intermediate points along the route. But fog often obscures the searchlights and it is then that the etherial waves are brought into action with a combination of coils and balancing instruments used in conjunction with the radio beacons located along the course. These aerial lighthouses radiate an electromagnetic wave, on which the pilot can train a radio compass and guide the plane accordingly.

Another serious problem which radio is helping to solve is the matter of bringing the airplane safely to earth in a thick fog. To accomplish this, neon lights have been installed at Croydon, which cast a reddish light capable of penetrating the fog. These lights extend horizontally across the field and are buried in small trenches covered by thick plate glass inserted at ground level, so that the machine will not "stumble" in hopping off or alighting. An underground "leader cable" is laid for some distance from the airdrome in a direct line toward Paris and it radiates a characteristic radio tone which the pilot can detect at a low altitude. He follows this signal until the neon lights are visible.

Recently the aviation authorities of France and England agreed that only machines carrying ten passengers or less will use radiophone and that larger craft shall be equipped with radio telegraph and a wireless operator. It is pointed out that there is less chance of error when code is used and, furthermore, the effective range of the telegraphic signals is about four times as great as voice transmission.

Radio as Safety Insurance

Europe today is credited with being far ahead of America in the development of civil aviation. However, it is predicted that aviation in the United States will forge ahead rapidly within the next few years. France is said to be the dominant nation in Europe as far as aviation is concerned today. France controls most of the international airlines and it is estimated that 70,000 of the 112,000 passengers over the airways last year rode in French planes. Today France has nine airlines, the most important of which is the Air Union. This is the company operating the Paris-London service and it is the busiest of airways. On busy days as many as 15 planes fly back and forth across the Channel with about 200 passengers. The next most important line is the Compagnie Internationale de Navigation Aerienne, the airway between Paris and eastern Europe to the Balkans and Turkey via Vienna and Budapest.

According to Dr. J. H. Dellinger, Chief of the radio laboratory of the Bureau of Standards, radio is going to have a kind of renaissance in an entirely new application now opening-up in civil aviation in America.

"Under the law recently passed by Congress, a powerful stimulus has been given to aviation, of which the public in the United States will see the fruits in the next year or two. Congress foresaw that this could not be accomplished without providing governmentally maintained airways and aids to aerial navigation. Of the latter the most significant is radio," says Dr. Dellinger. "Many persons informed in aviation say that its success is entirely dependent upon the practical adaptation of radio as a safety insurance and as a means of expediting navigation through the air. This use of radio is only beginning, but will go forward rapidly and hand in hand with the forthcoming developments in civil aviation.

A RADIO-EQUIPPED AVIATOR

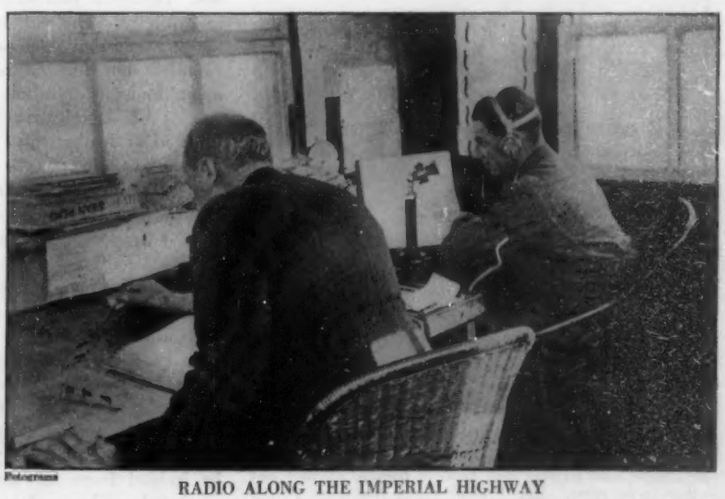
Pilots on planes flying from Croydon to LeBourget have radio headsets in their helmets and microphones on straps around their necks. These are connected to radio sets

"The great problem of the airplane today is in landing," says Dr. Dellinger. "Aviators declare that no mechanical instrument up to the present time gives them sufficient confidence to land when the ground is invisible. The radio beacon can guide a pilot to the landing field and its exact location can be given to him by a field localizer, but there still remains the problem of indicating to him the exact distance above the ground during the last few feet of descent and actual landing."

The Bureau of Standards is at present engaged in building a model airway. In connection with this, experimental research work is being undertaken on those features of radio aids which are not yet available in sufficiently perfected form.

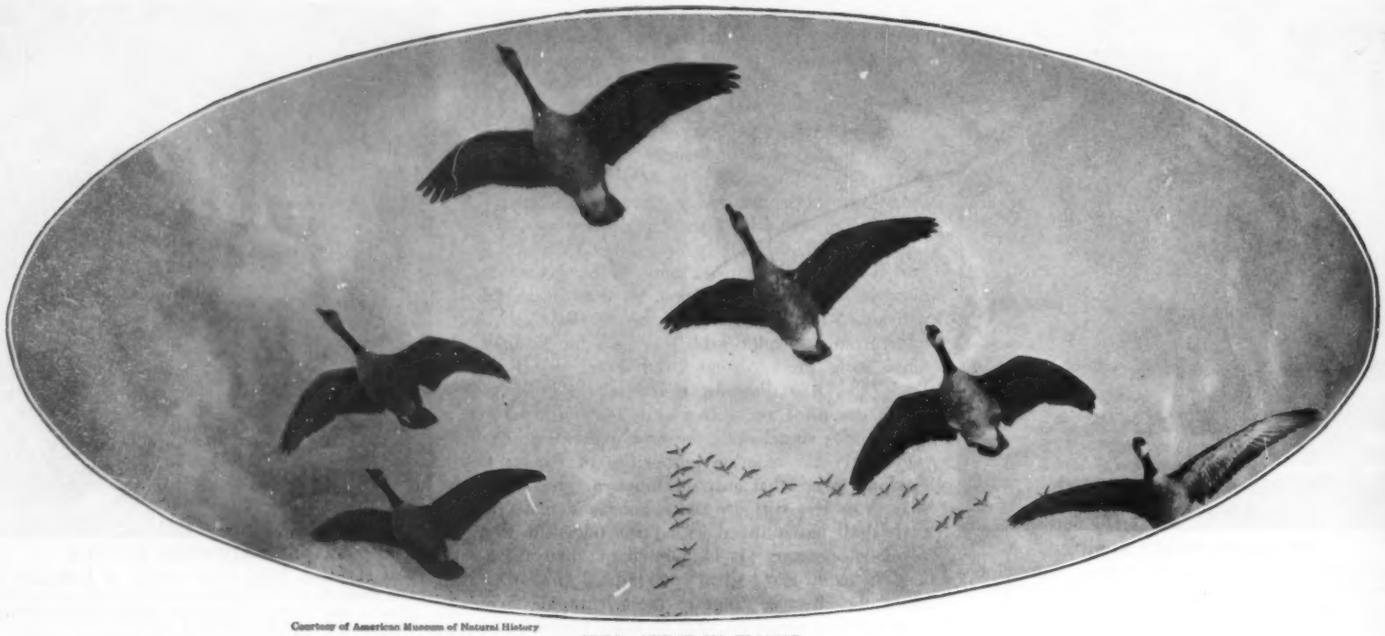
KEEPING TRACK OF THE AIRPLANES

Each navigator flying from Britain to France sends frequent reports of his position by radio, and the progress of the plane is followed constantly on a large map



RADIO ALONG THE IMPERIAL HIGHWAY

Planes plying between London and Paris maintain communication with the home field. Operators above talk with the pilot and chart position of plane on map



Courtesy of American Museum of Natural History

WILD GEESE IN FLIGHT

Wild geese in flight formation, winging their way to the warmer countries of the South. During their journey, they stop over at certain resting places, where they find food and water. The favorite resting and breeding places of migratory birds are shallow ponds and marshlands

Uncle Sam, Spendthrift—VII

The Threatened Extinction of Some of Our American Game and the Valiant Fight that Is Being Made to Save the Remnant

By J. Bernard Walker

IF you had landed with the first settlers in America, and, with the early explorers, had crossed the prairies and mountains of western America, you would have found the country to be densely inhabited by unbelievable millions of game—both big and small. Perhaps it will surprise the reader of these lines to learn that the leading naturalists of today are of the opinion that two of the choicest of our big game—the buffalo and the antelope—equalled, if they did not exceed in numbers, the total present-day human population of the United States. If you doubt this, read the following from a recent bulletin of the Department of Agriculture:

"Where the pronghorn antelope occurred with the buffalo, people best qualified to judge consider that it exceeded that animal in numbers. It has been estimated that the buffalo herds at one time numbered from 30 to 60 million animals. In view of the greater territory occupied by the pronghorn antelope and its known abundance, it may be considered a conservative estimate to place its probably original numbers at not less than 30 to 40 millions and possibly more." At the date of that bulletin—August 1925—a census by the Biological Survey showed only approximately 30,000 scattered survivors. Today the buffalo is represented by a few herds in captivity. The sad story of the slaughter of the buffalo and the antelope, which would have been complete but for the intervention of our government, finds its parallel on a lesser scale in every species of American wild game—big and little—fur-clad or feathered.

Courtesy of "Field and Stream"

BUFFALO IN WAINWRIGHT PARK

When the white man arrived in America, the prairies and grasslands were teeming with herds of buffalo, antelope and other large game. The United States Biological Survey estimates their number at that time as being from sixty to one hundred millions or more

Wholesale Destruction for Profit

With the advent of civilized man, with his improved weapons, team work, and commercialization, the great herds of game began to disappear like a snowfall before a hot sun; for where the savage killed to meet his necessities, the white man killed in a wholesale fashion for gain. He pushed out over the prairies in wagons, the huntsmen killing the buffalos and the butchers skinning them, leaving the carcasses to rot where they fell. The hides were sent back to market. The total slaughter of buffalo by white men in three years—1872 to 1874—may be judged from the statistics of animals actually marketed. The railroads reported shipments of 1,378,359 hides, and remembering that in 1872 one hide sent to market represented three dead buffalos and two in 1873, this would mean a total slaughter of 3,158,730 buffalos. How rapid was the extermination may be judged by the fact that about three million of these animals were killed in the first two of these years, while in the third year only 158,583 were slaughtered. The Sante Fe Railroad reported that during the same three years, 2,250,400 pounds of buffalo meat and 10,793,350 pounds of bones of these animals were shipped over its lines. There was a great slaughter in the years 1880 to 1884, because of which the buffalo was practically

Courtesy of "Biological Survey"

MOUNTAIN SHEEP FEEDING

This view taken in Yellowstone Park shows part of a flock of mountain sheep, which, like many another species of the wild game of the United States, was threatened with extinction. Thanks to protective measures, they now number in the neighborhood of ten thousand

exterminated as a wild species. A census taken in 1889 showed only 1,091 animals wild and in captivity in the United States and Canada. Estimates made in 1920 of the number of big game in the United States other than deer were as follows: buffalo 3,400; elk 52,000; antelope 7,500; moose 7,000; mountain goats 6,000; mountain sheep 10,000. These totals are exclusive of the game of Alaska and Canada.

No more deplorable instance of the spendthrift policy of Uncle Sam in regard to his wealth of national resources is recorded than that of the all-but-complete extermination of the fur seals of the Pribilof Islands off the Alaskan coast. In 1909, the Bureau of Fisheries said, "The Alaskan fur seals constitute the most valuable fishery resource that any government in the world ever possessed. It is a little less than a national disgrace that the herd of four to six million seals which came into our possession when Alaska was acquired from Russia should have been allowed to dwindle until, today, it numbers less than 150,000 of all ages." The utter extinction of these valuable herds was prevented by the Seal Fisheries Convention between the United States, Great Britain, Japan and Russia, signed July 7, 1911. Since that date the seal herd has been under the management of the Department of Commerce. From 1911 to 1921, the herd had increased from 150,000 to 581,453.

Sound Reasons for Conservation Policy

When the buffalo had been practically exterminated, there began to develop great markets in our leading cities for quail, grouse and wild fowl, and an extermination of game birds was threatened similar to that of the big game of the west. However, this was stopped by the Federal Act of 1900, which prohibited interstate commerce in game killed in violation of the state law. Then, in 1918, followed the prohibition of the sale of migratory game birds under the Migratory Bird Treaty of 1918.

In answer to the question as to why the government should go to the expense of protecting the game of the country, we reply that the reasons are those of sentiment, recreation or sport, and material profit. The sentimental appeal calls for no emphasis by the writer. Surely no lover of his country can contemplate with composure the extinction of the lordly buffalo and moose, or of the antelope, so beautiful of form and graceful in action—since these so intimately and boldly stand out on the early historical background of America.

As for considerations of sport, let it suffice to say that, under the present federal and state safeguards,

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THE LORDLY MOOSE

There is no species of the big game of the United States and Canada that is more admired and more eagerly sought by the hunter than the lordly moose. Its remote habitat renders the protective work of the game warden difficult

the hunting of wild game—big and little—is a legitimate, healthful and humane means of recreation. We have in mind when we say this, the "hunter," not the "killer." The taste for wild game as food—whether of the field, the water, or the air, has come down to us from the age when this was practically the only food that was daily available for the human race. Modern restricted hunting, far from being wasteful and cruel, is the only practicable means of conserving our wild life. This it does by withdrawing a certain percentage of the game for use as food, thus preventing too great an increase, and consequent death by starvation.

Not many people understand the great value of the product of the huntsman's gun. A former Secretary of the Department of Agriculture, in a report on March 29, 1924, estimated that, annually, more than six million people in the United States were engaged in hunting of one kind or another. The beneficial effect upon these citizens, of enticing them into the open and giving them relief from the nerve-racking competition of our industrial age, is beyond calculation. Furthermore, the annual "kill," far from being a waste, has a very real monetary value. The State of Idaho has placed this at a million dollars; Michigan at 4,975,377 dollars; Pennsylvania at six million; Wisconsin at about four and one-half million. Eight states have estimated the annual aggregate monetary value of the game at 25,746,916 dollars. The Chief of the Biological Survey, capitalizes this at 6 percent interest and reaches a total value of 430,000,000 dollars. Assuming that only one-third of the wild life is found in these eight states, he considers a capitalized value of the annual "kill" in the whole United States of one billion dollars to be a conservative estimate of the total.

Bird Refuges Needed

Transcending in importance every question of game conservation today, and calling for immediate action, is that of saving the aquatic, migratory birds of America—ducks, geese, swans and various others. The Migratory Bird Treaty of 1916, between Great Britain and the United States provides for the protection of the great flocks of migratory birds which pass back and forth between Canada and this country each year. This treaty and the Federal Act stopped the sale of migratory game birds and forbade the shooting of them in the spring. But another peril to bird life has arisen in the rapid extinction of those water areas—ponds, marshlands, et cetera—which are used by the wild fowl as resting and breeding places during their long flights south and north. For many years the drainage of these water areas has gone on steadily, more or less regardless of whether such drainage would or would not be beneficial to the owners. This depletion has caused a fatal congestion of the birds in the remaining areas, where food is insufficient and the birds have died of starvation. In such cases, there has been a frightful loss of bird life.

There is now before Congress the Migratory Bird Refuge and Marsh Land Conservation Bill, which should receive the active support of every friend of conservation and lover of bird life. The annual fee imposed with every hunting license will provide sufficient funds for the purchase of the necessary bird refuges and pay for the proper upkeep and oversight.

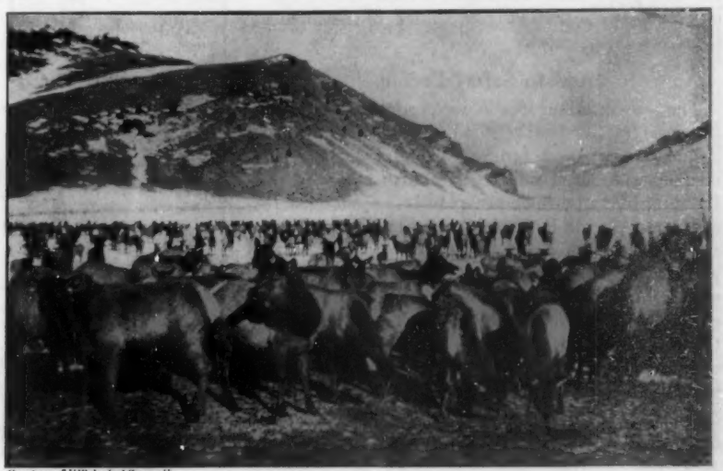
Write to your congressman!

¶ *In considering our wealth of natural resources, do not overlook the rich virgin soil of the country. Down through the years, successive crops were raised with no attempt at refertilization. Forests have been cut down and the soil washed into the valleys. The story of this appalling waste will appear in an early issue.*

Photo by U. S. Forest Service

A FAMILY ROW

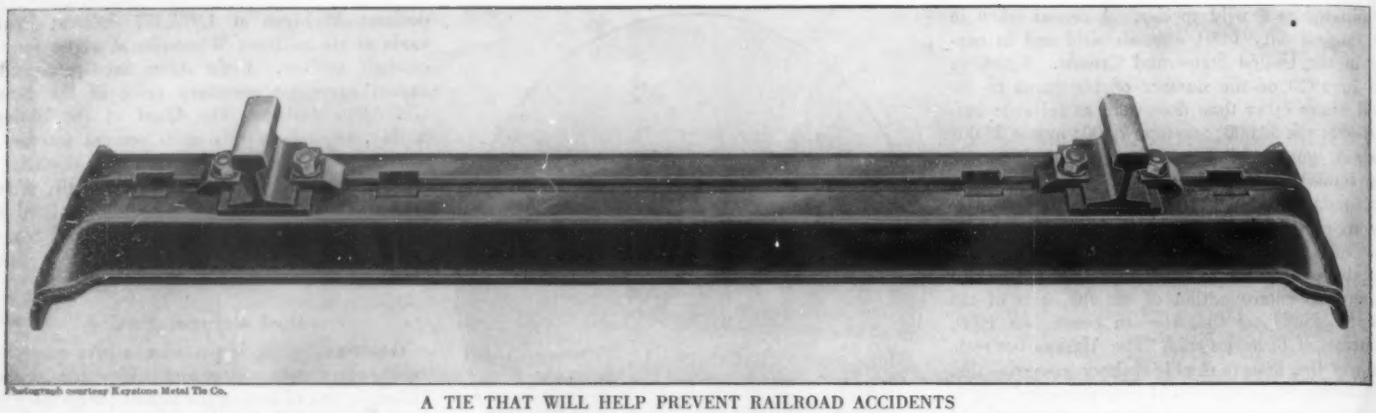
Yes, there are family differences, now and then, even among the so-called lower animals. Apparently, Bruin Junior takes sides with mother. The photographer snapped this picture in the Wasatch National Forest, Utah—a game refuge. It is by such wild-life refuges and by stringent regulation of hunting that our game is being preserved



Courtesy of "Biological Survey"

A FINE HERD OF ELK

The photograph of this herd of elk was taken in the winter and shows them feeding on the fodder provided by Uncle Sam for their sustenance. As the herds increase, the young trees, bushes, and grass afford insufficient browsing. If provision was not made for the feeding of these animals, they would soon die, victims of civilization



Photograph courtesy Keystone Metal Tie Co.

A TIE THAT WILL HELP PREVENT RAILROAD ACCIDENTS

Metal ties that will stand the strain of rail traffic and will not rust are the logical ones to replace present wooden ones

Is the Wooden Railroad Tie Doomed?

The Advent of a New, Non-corrosive Metal Tie That Is Far Stronger Than Wood Sounds a New Note in Railway Engineering

WHEN compared with the railroads of 1830, it must be admitted that our present day trains offer the traveler a maximum of physical comfort. Vast strides have been made in the production of equipment and rolling stock; rock-ballasted roadbeds and expansive block signal systems contribute to safety; powerful locomotives draw long, heavy trains over high mountains and across broad deserts. Yet, does the knowledge of all this ease the mind of the nervous passenger and assure him that he will reach his destination in safety? He reads in the daily papers of wrecks caused by spreading rails or by the loosening of spikes in the antiquated wooden ties and then suddenly realizes that he is traveling over a roadbed that uses just this type of ties.

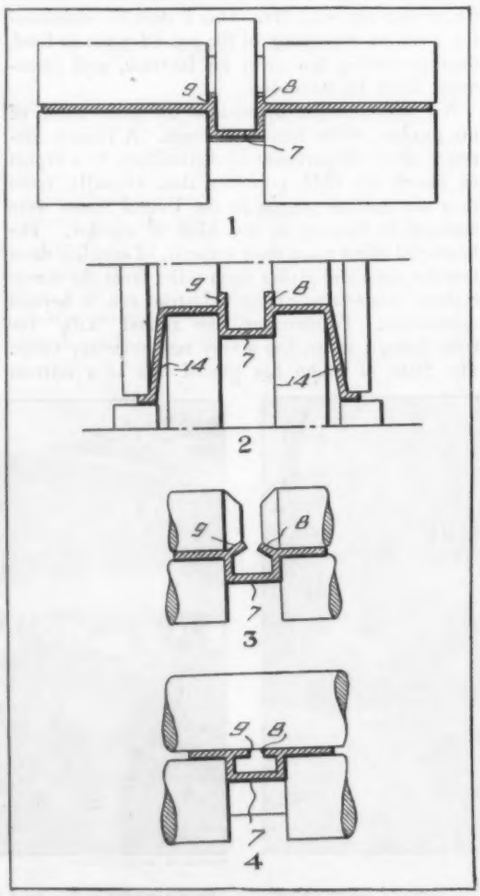
With all the improvements that have been made in other branches of railroad service, is it not surprising that wooden ties are still in almost universal use? Here is probably the most important feature of railroad equipment—a vital link in the foundation of the system—standing today, as it has almost from the inception of railroading, with practically no improvement. True, experiments have been made with concrete and with metal ties, but these, up to the time of the invention of the tie described on this page, have been unsatisfactory, the main objections to them being a matter of mechanical construction and cost.

Add to Safety Factor

The specifications for a metal tie are stringent. It must be practically non-corrosive; it must be shaped so that there can be no lateral displacement on the roadbed; it must have a firm and sure rail fastening device which can readily be removed for rail replacement; it must be capable of positive insulation from the rail; and most important of all, it must compare favorably with the cost of present equipment. This last factor has heretofore been a great deterrent, for despite the fact that less metal ties are needed per mile, because of firmer adherence to roadbed, larger contact surface with the rail, and stronger and more positive anchorage to the rail, still the cost of manufacture has previously made such a comparison unfavorable.

It has remained for industrial engineering to solve the problem by producing a satisfactory steel tie which fulfills all requirements. An ingeniously devised method of rolling steel containing a small alloy of copper, now makes possible a tie that will last fifty years. One of the largest transportation systems in the world—and one often referred to as the model of American practice—has adopted it as their standard.

From a steel billet of about 250 pounds weight, containing an alloy of copper, the first forming operation produces the trough 7 shown in Figure 1; at the same time, the lips 8 and 9 are squeezed up by the pressure. Next the exterior webs 14 are crimped down. See Figure 2. Figures 3 and 4 illustrate the final flattening of the lips which were previously formed. This fashions the rail-bolt slot. The "whale-tail" ends are formed in an hydraulic press, during which process collapsible shearing dies are inserted in the bolt slot. Upon the recession of the press plunger, these dies cut out the notches into which the rail bolt-heads are inserted. Thus, an integral rolled tie is obtained, the bolt recess of which forms a stiffening web with the sides. This gives a strong, well-designed, hollow fabrication with uniform cross-section, free from holes or rivets. The blocks and bolts which hold the rail in absolute alignment are readily worked upon from above. Insulation is obtained by the interposition of non-conducting plates and bolt caps between the tie and the rail. Because of the greater positive bearing surface of the rail on the tie and the rigid locking system, less ties per mile are required than under the present practice which requires approximately 3,000 ties per mile. Infinitely greater safety is obtained with steel ties and the resiliency of steel construction makes for greater smoothness of running.



HOW THE TIES ARE MADE

The four main steps in the manufacture of the new metal ties are shown above and described in the text

Eliminates Spreading of Rails

Comparative tests of the maximum lateral pressure that can be withstood by a rail spiked to a wooden tie and by the metal construction detailed here, show that at 4,500 pounds pressure, the two spikes on the near side in the wooden tie were pulled out and the two spikes on the far side were forced back into the wood. The same test with the metal tie showed no failure in the attachment, but at 33,500 pounds pressure, the rail section itself was bent at the web. With a 100-pound steel rail, no rupture to the steel tie was recorded until 46,000 pounds pressure had been reached.

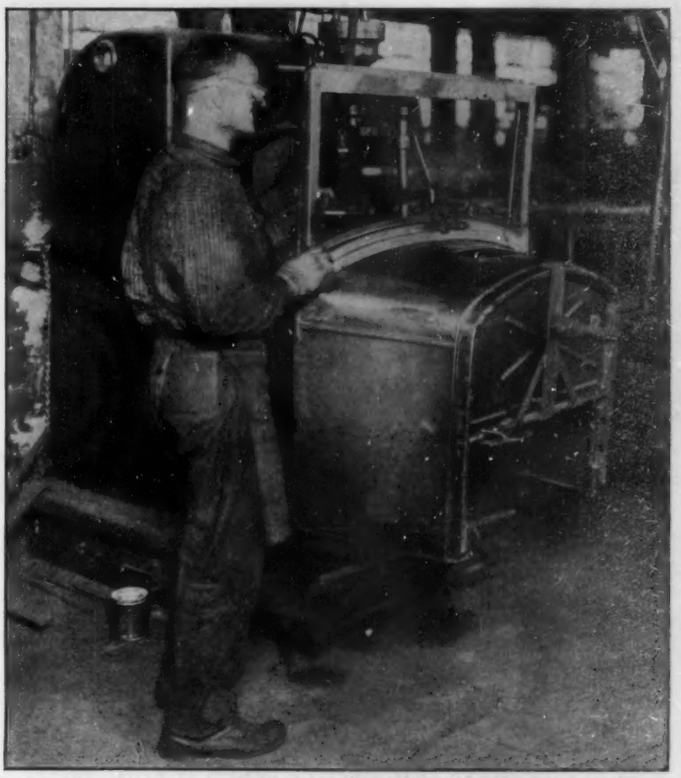
The splendid results of the safety campaigns maintained so vigilantly by the roads, which have already paid large dividends in the saving of life and property, will be greatly enhanced when the menace of track failure is entirely removed. It will not be many years before the passenger may let his thoughts wander in profitable channels, secure in the consciousness that the greatest danger of railroading—a wreck from spreading rails—has been definitely and positively removed.

As in most worth-while inventions, the story which is so easily and quickly told, represents years of experimentation, persistence against prejudice, and last but most important of all, the attainment of production within a reasonable approach to the cost of current practice.

All photographs courtesy Edward G. Budd Mfg. Co.

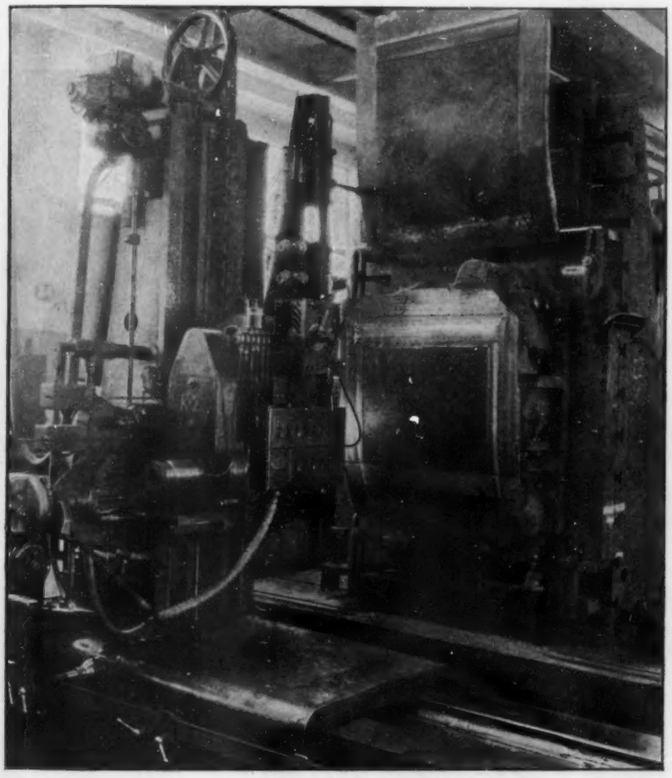
COMPLETING THE ASSEMBLY

Jigs carried by the heavy uprights hold the several parts to the standard over-all dimensions and the body is finally welded as a unit. This operation takes only 45 minutes. The strength of the jigs prevent variations in the finished shape of the body



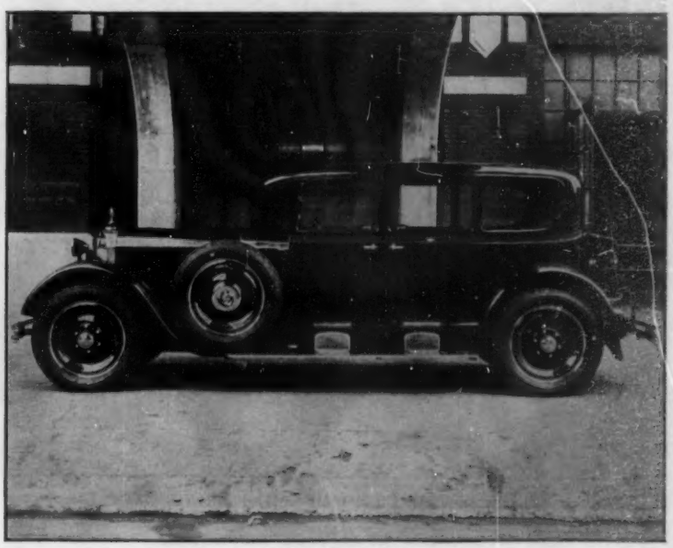
COWL ASSEMBLY

After leaving the huge presses where they have been formed from sheets, the cowl and assembled wind-shield are suspended in place, when, upon pressing the foot lever, the complete assembly is spot-welded along the entire length of the touching surfaces



A MODELING MACHINE

Back of the push-button control panel in the center of our illustration, is the light attached to the hob milling-cutter, the movement of which accurately follows the guide, shown immediately above, as it works up and down on the model following its contour

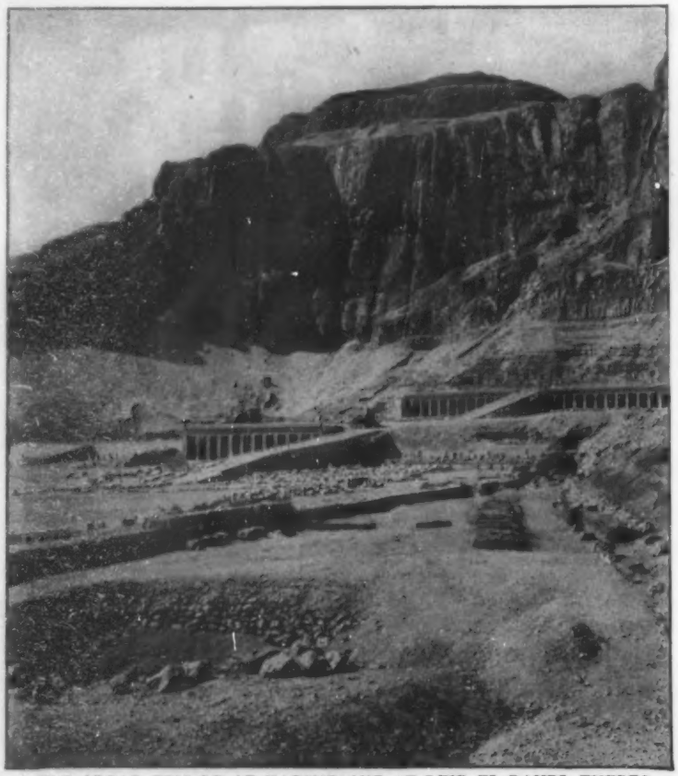


THE UNIT BODY

Completed and practically as uniform as one piece of metal, the strength and safety of an all-steel body as well as the possibility of the application of a beautiful finish, as shown above, further enhance the value of the finished product, in the eyes of the public

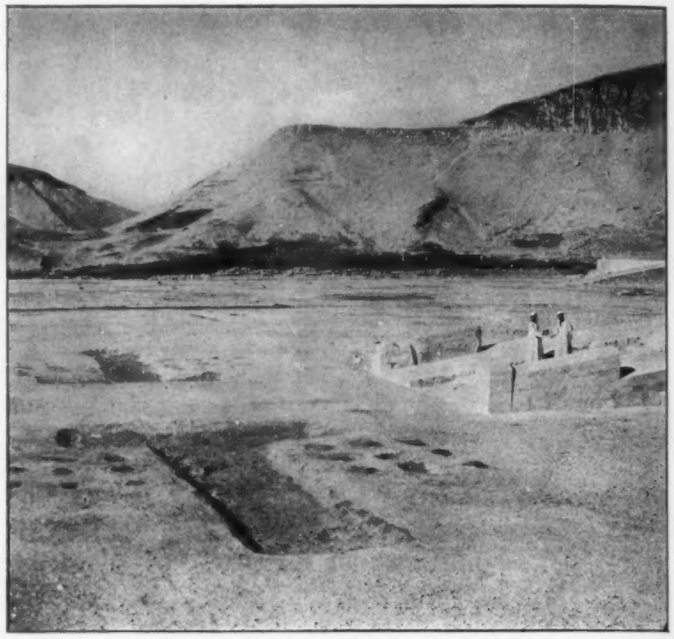
The Manufacture of Unit Automobile Bodies

The statement that only five makes of automobiles manufactured in this country utilize closed all-steel bodies will undoubtedly cause surprise, yet, such is the fact; two of this number being added during 1926; only one dating from 1914. It is quite recently that the manufacture of these bodies has been perfected to a point where they can be produced economically for either large or medium output. The important elements in this development are an improved process of manufacturing the dies necessary to make the steel stampings and refinements in spot-welding the assembled parts, whereby the finished body becomes a metal unit. Whereas in the past it required eight months to manufacture these dies, automatic machines now produce them in less than two months and the assembled parts, held to standard measurements by specially designed jigs, can be spot-welded practically as one piece of metal, in the remarkably short time of 45 minutes. Present designs closely follow the forms prescribed by wood construction, but it will be readily apparent that steel construction is much neater. It can be fabricated with equivalent strength and yet materially increase the cubic capacity of the body, while the one piece formation offers a considerable additional factor of safety for the occupants.



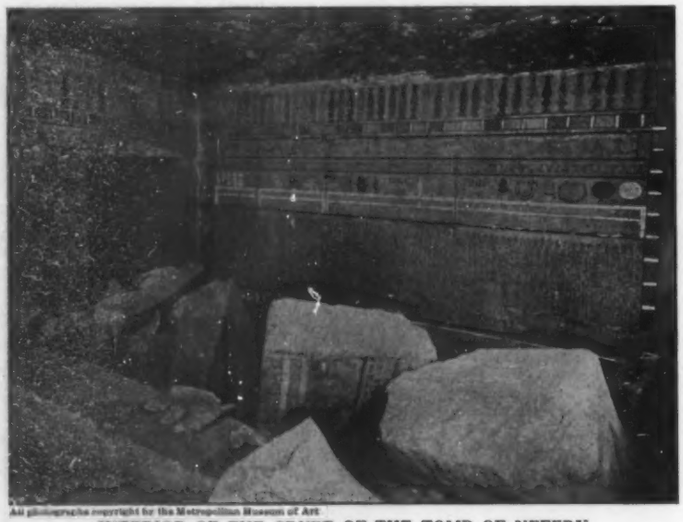
THE GREAT TEMPLE OF HATSHEPSUT AT DEIR EL BAHRI, THEBES

The excavations carried on here for a number of years have produced results that are very important to students of archeology



REMAINS OF THE GARDENS AT THE FOOT OF THE RESTORED RAMP

The landscape architect was very particular about his "formal garden" and dug pits so that trees could be grown in earth



All photographs copyright by the Metropolitan Museum of Art

INTERIOR OF THE CRYPT OF THE TOMB OF NEFERU

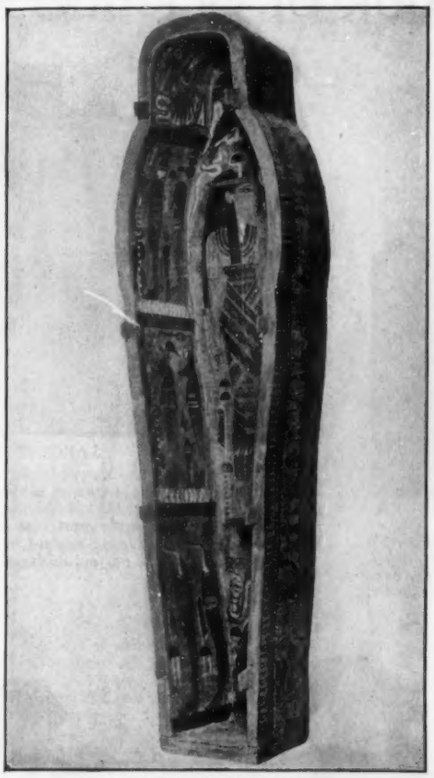
Here scraps of sculpture bear the names of tourists who had scribbled on the walls thirty-five centuries ago, just as tourists do today

CARRYING MAIT'S COFFIN THROUGH THE TEMPLE RUINS

This is typical of the scenes which may be observed when an important archeological find is made in one of the ancient tombs in Egypt

Egypt the Mysterious Beckoned the Tourist 3500 Years Ago

The Egyptian archeologist formerly spent his time half the year on the spot burrowing under ground, bossing gangs of native workmen and salvaging the delicate finds. The other half of the year was devoted to drawing up papers, classifying exhibits and making measurements in the home museum. In a twinkling of an eye, Lord Carnarvon's and Howard Carter's discovery of the tomb of Tutankhamen changed all this. The archeologist finds himself with his every movement photographically recorded. He cannot even remove an ancient nail without five continents knowing all about it by breakfast time next morning. Such espionage and inflated publicity was not without its bad effects. In consequence of the radical changes by the Director-General of Antiquities at Cairo, a decision was reached by the trustees of the Metropolitan Museum of Art to await the outcome of negotiations seeking adequate assurance under the new regulations as to fair and equitable conditions for future work. In the past three years, we have published annually an account of the excavations at the Museum's concessions at Thebes and Lisht, and we now give the results of the investigations of the archeologists for the year, or rather the season, of 1924-1925. At Thebes, the excavations are carried on in the Theban necropolis, and the results have added much to our knowledge—not only of history but manners and customs as well, which so captivate the imagination of the public. Some remarkable things are disclosed, such as the actual plans of the landscape-architect for the formal garden. These plans indicated where the pits were to be dug for the trees. A little later the archeologists found the pits themselves with the earth and tree stumps.

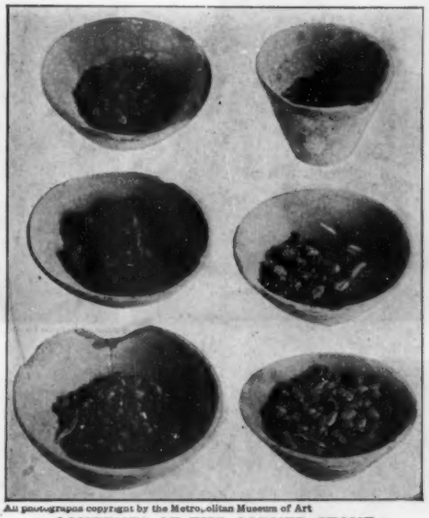


A POLYCHROME COFFIN

The bizarre art of Egypt is nowhere better shown than in the colorful coffins

REMAINS OF THE TEMPLE AT LISHT FROM THE PYRAMID

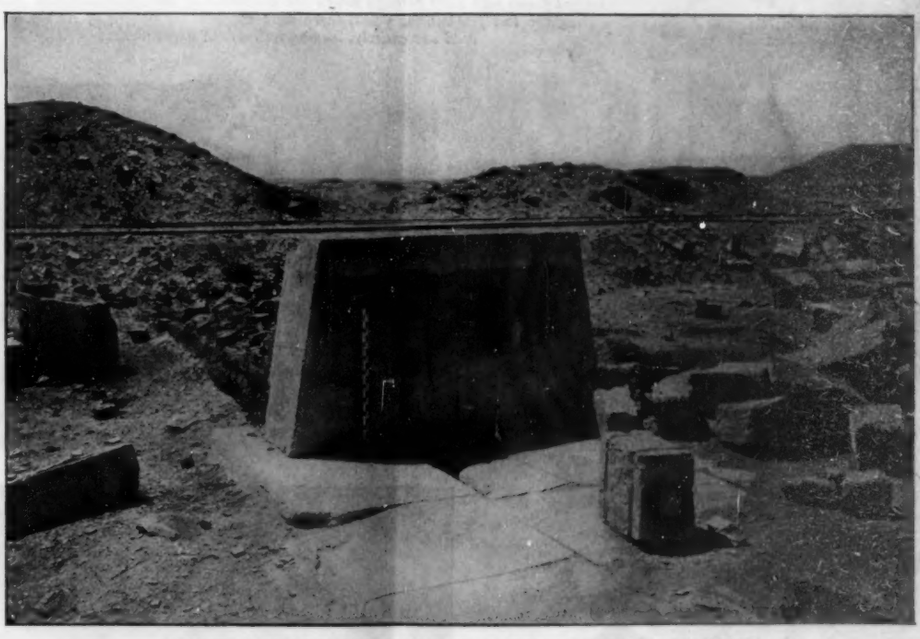
To the unitiated, ruins seems confused but, in time everything is made so clear by the labors of the archeologist that the inner and outer courts, and the sanctuary are differentiated



All photographs copyright by the Metropolitan Museum of Art

CONTENTS OF THE CORNER STONE

At "the stretchings of the cord" or laying the corner stone, samples of food were buried



SITE OF A TEMPLE DOORWAY AT LISHT RECENTLY UNCOVERED

The outer enclosure of the temple was reached through two doorways, one on each side of the main entrance of the temple. This shows all that remains of one of the doors

Remember this in a desert where, if you want anything to grow, you have to bring in the earth. Very curious discoveries showing the continuity of human nature and social custom have been made at the Theban site. Here we find four foundation deposits, like the contents of a modern corner-stone, which were placed there on the day when the haughty Hatshepsut and her architects laid out her temple 3,500 years ago. These deposits contain models of tools and samples of the food to be the eternal provision. Here we find figs, dates, grapes and even celery. In the tomb of Neferu there were found scraps of pleated linen retaining the folds ironed into them four thousand years ago. This is very gripping and so are the names of the tourists who scribbled on the walls 3,500 years ago. The ancient robbers broke into the crypt and stole everything in sight. They made a thorough job of it and tore down the wall to make certain there were no further passages. Every stone torn down lies there today, as shown in one of our illustrations. The later temple porch was built right across the entrance to the tomb so how could the ancient tourists have gotten in? In deference to the antiquarian feeling of the time (about 1600 B. C.) a narrow tunnel descended to the door of Neferu's tomb. The archeologists of today reopened it and it certainly gives a human touch, bridging a vast lapse of time. At Lisht, the investigations of the pyramid temple of Sesotris I and the adjacent area have now resulted in the recovery of the essential features of the plan of that structure. The general view which we show does not disclose much to the lay mind, but the archeologist fits stone to theory until every point is definitely settled. The rooms in the front half of the temple are of such a nature as to lend themselves to celebration of a more or less public character, while the chambers in the back part must have been devoted to the private ceremonial worship of the deified king where only the elect could enter.

From the Scrap-book of Science—Cam

Underwood & Underwood

TAMING WILD MACHINE-GUN FIRE

Col. R. M. Cutts, United States Marine Corps, with an automatic rifle equipped with the Cutts compensator designed to prevent dispersion of fire due to recoil in automatic rifles and machine guns. It was invented by Col. Cutts and his son, Lieut. R. W. Cutts, Jr.

Times Wide World

GRAIN-ELEVATOR DUST DRIVES FORD ENGINE

United States Department of Agriculture research men have succeeded in running a gasoline engine on explosive grain dust. With enlarged combustion chamber, a hot, six-ampere, 100-volt spark and hand fuel-feed, they kept the engine running, once getting twelve successive explosions—a crude but encouraging start. Long ago Dr. Diesel, co-inventor of the Diesel engine, suggested a similar use of coal dust. The invention of a practical dust engine is hoped for

Herbert Photos, Inc.

LARGEST STORAGE-BATTE

This new type of 110-ton storage-battery locomotive is capa empty or 30 loaded freight cars, at a speed of eight to ten Northwestern Railroad and will be used in the Chicago weighs 39 tons. Within the past year or two, several rail engine with electric and Diesel-engined locomotives, thus effec type consume no fuel during the comparatively lo

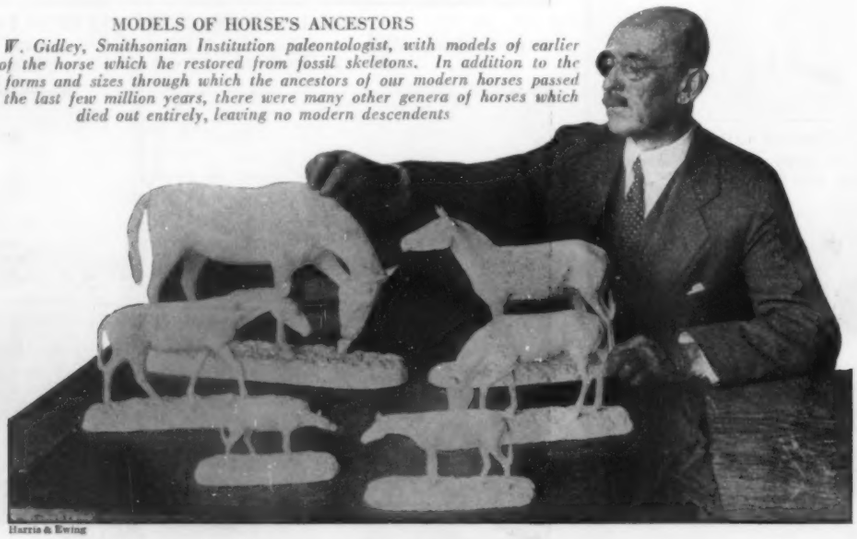
Science Service Photo

THE ERECT-WALKING APE-MAN

This monument was erected by Dr. Eugene Dubois, Dutch scientist, to mark the spot where he found the remains of Pithecanthropus erectus, *the ape-man of Trinil, Java, 35 years ago. Recently a new ic of* Pithecanthropus *was found near the same by another Dutch surgeon whose search fol- ed the recent visit of Dr. Ales Hrdlicka, Amer- n anthropologist, to Java and his recommenda- tion that further search be made on this site*

MODELS OF HORSE'S ANCESTORS

Dr. J. W. Gidley, Smithsonian Institution paleontologist, with models of earlier forms of the horse which he restored from fossil skeletons. In addition to the several forms and sizes through which the ancestors of our modern horses passed during the last few million years, there were many other genera of horses which died out entirely, leaving no modern descendents

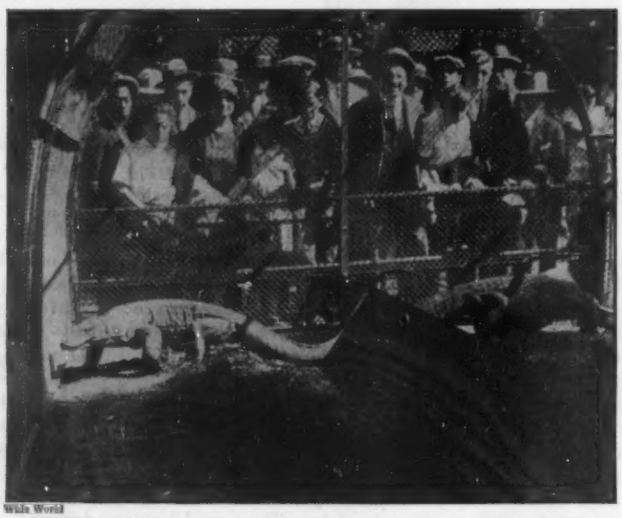


Harris & Ewing

Science Service Photo

UMBRELLA STAR-CHART

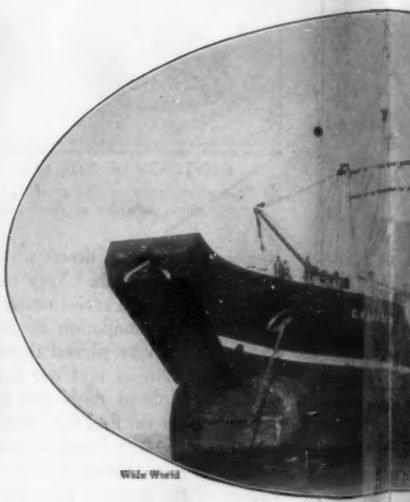
Duncan McEwan of Scotland painted the constellations on an umbrella, which, being curved instead of flat like the ordinary star chart, retains the proper spatial relations between the stars. This is the simplest and cleverest star map we have seen



Wide World

LITTLE-CHANGED DESCENDENT OF ANCESTRAL PROTOTYPE

Two rare specimens of Varanus, *captured in Komodo, near Borneo, have reached the Bronx Park Zoo, New York. They differ but little from* Veranops, *a fossil reptile of the Permian Period, 90,000,000 years ago, which might have been the ancestor of all later reptiles, including the dinosaurs, and mammals*

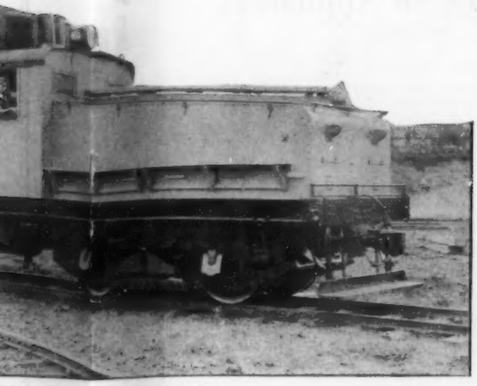


Wide World

MODERN "MASS PRODUC

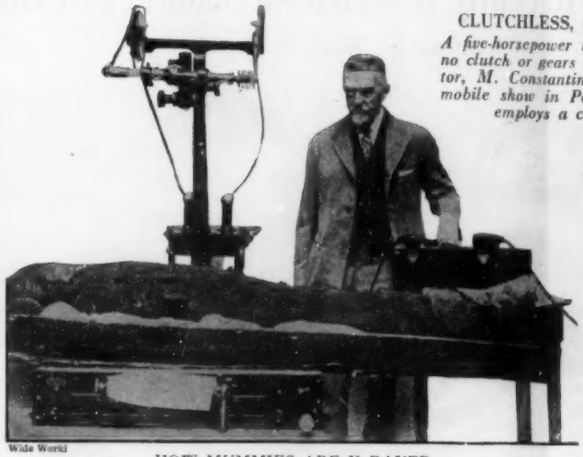
A ship that literally swallows whales has recently be opens, admits the whale into a sealed chamber, and pumped from the special whale chamber and it is unse to be turned then and there into

-Camera Shots of Scientific Happenings



TORAGE-BATTERY LOCOMOTIVE

locomotive is capable of hauling a 1,500-ton train, equivalent to 70 d of eight to ten miles an hour. It was built for the Chicago and in the Chicago yards of that system. The storage battery alone two, several railroads have replaced the old-time steam switch motives, thus effecting a considerable saving. Engines of the latter e comparatively long intervals between actual switching



Wide World

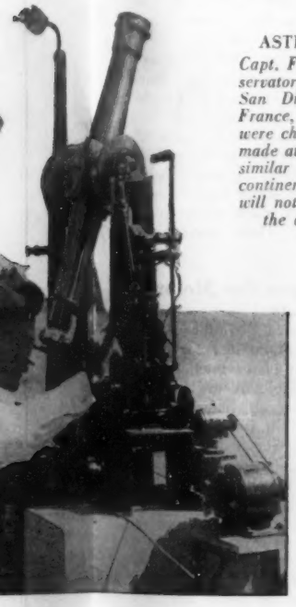
HOW MUMMIES ARE X RAYED

Fifty Egyptian and South American mummies are being X rayed at the Field Museum, in Chicago. This method obviates the necessity of unwrapping the mummies in order to learn about their anatomy

CLUTCHLESS, GEARLESS MOTOR

A five-horsepower two-cylinder motor with no clutch or gears was shown by its inventor, M. Constantinesco, at the last automobile show in Paris. The transmission employs a centrifugal device

Wide World



ASTRONOMERS TEST CONTINENTAL DRIFT

Capt. Frank B. Littell of the United States Naval Observatory at Washington, making transit observations at San Diego, California, as Col. Charles Mailles, of France, records the observations. These observations were checked by radio signals with similar observations made at Shanghai, China, and Algiers, Africa. If, when similar observations are made several years hence, the continents have drifted even a few feet, the same stars will not pass the cross-hairs at the instant predicted on the assumption that the continents are stationary

Wide World

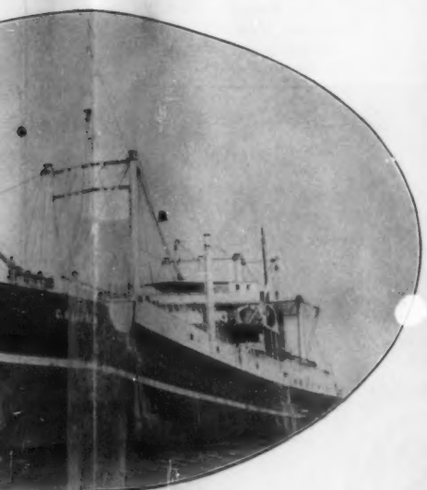
HOW PLASTIC IS LIME?

The United States Bureau of Standards has perfected an apparatus for measuring the plasticity of lime, such as that used in plaster for walls

Fotogram

MARTYR TO SCIENCE

Doctor Lobligeois, French surgeon, of the Bretonneau Hospital, Paris, who recently lost his right arm because of the effects of radiations from radium. He was decorated with the Legion of Honor. The beta rays from radium are electrons flying at 175,000 miles per second



"MASS PRODUCT" WHALING

s has recently been built. The trap door under her prow ed chamber, and closes behind the whale. The water is ber and it is unsealed. The whale is now aboard ship, ready and there into whale oil and whale meat

Wide World

TELEVISION BY TELEPHONE

J. L. Baird, a Scottish inventor, has been working for some years on a method of seeing at a distance by electrical means. The round insert shows what has been accomplished so far—three dolls are moved before the distant transmitting apparatus, and the movements are seen beside the telephone

Keystone

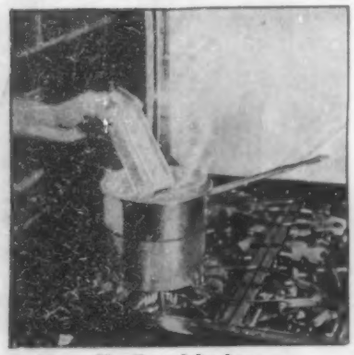
AMATEUR SCIENTIST PERFECTS ULTRA-MICROSCOPE

With the best microscope and ordinary light one cannot see objects less than one 135,000th inch apart but J. E. Barnard of London (seated) has perfected a microscope of twice that power. It efficiently employs the shorter waves of ultra-violet light

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins



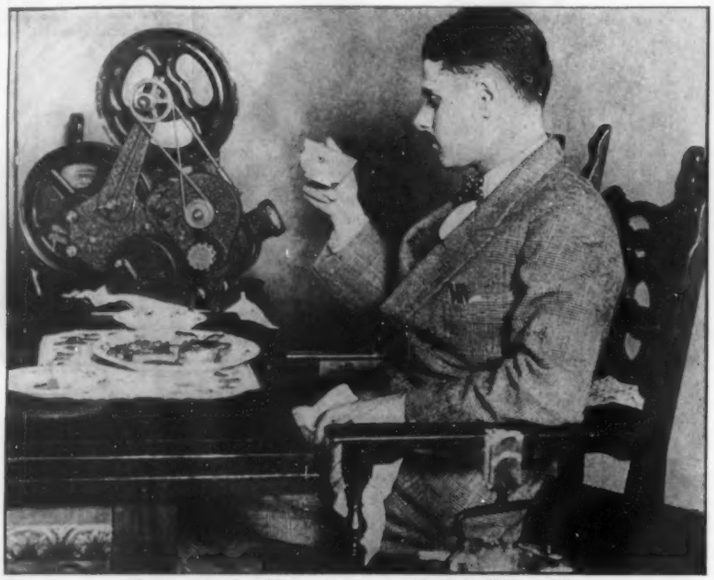
Unaffected by heat

New Nursing Bottle Resists Heat and Cold

SIX-SIDED glass nursing bottles are now being made out of a fire resisting glass. The purpose of this is to provide a bottle that will not crack when it is subjected to sudden changes of temperature. This bottle also has the advantage that it will not roll like a round bottle when laid on its side.

New Machine for Reviewing Films

THE device illustrated enables the busy motion picture executive to review films no matter where he happens to be. The film in action is seen through the eyepiece, although it is not necessary to apply the eye closely.



Reviewing the film program at the breakfast table

Siren Calls Life Savers

WHERE there are long bathing beaches, there is always a loss of time while someone goes to summon a life saver in a case of emergency. The mechanical siren illustrated was designed to do away with this loss, which sometimes is fatal. The device is mounted on the top of a high pole and is controlled from a box, similar to that of a fire alarm, which is located near the base. To operate, it is only necessary to break a small glass in the front of the box, whereupon the siren sets up a shriek that can be heard for several miles.

All-Steel Golf Bag Rack

AN all-steel rack for golf bags makes them last longer and prevents warping of the clubs, which often results from leaning bags against the wall. The golfer who pays today's stiff prices for a smart bag wants it to keep its good looks for a long time. The smooth, enameled steel shelves, curved to fit the bag, cannot scratch the leather and canvas as wooden racks do. Bags can never catch on bolts and the curve prevents the bag from rolling. Bags can also be located more quickly by use of this rack, doing away with long searches. Any bag can be located at a moment's notice by means of a holder containing an identification card. More space for clothing is available in lockers when this steel rack is used for holding the bags. The economy of space is very evident as steel construction always results in a shrinkage in the size of the supporting members.

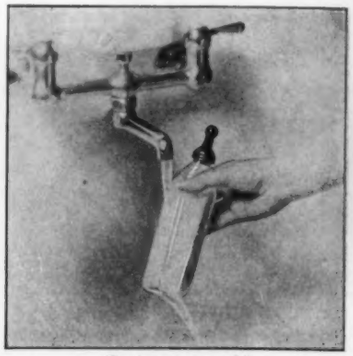
A mechanical beach siren

Longer life for the golf bag is insured by this rack

Oil Engines Reclaim the Desert

IN the waterless desert, where natural power does not exist, oil engines are developing profitable industry by generating accessible power. A striking example of this may be found at Gerlach, Nevada. Here, in the granite mountains, a rich deposit of rock gypsum was discovered. It was ten miles from the nearest railroad and, being in the heart of the desert, coal was not obtainable. There was neither power, nor water, and there were no housing facilities.

The corporation quarrying the gypsum to make plaster of various kinds has overcome all these difficulties. A great mill has been erected and is running full blast, a five-mile aerial conveyor has been provided, a plant railroad has been built, an attractive village for the workmen has been constructed, as has also a large power house from which emanates electric power. Where once the desert lay silent and untouched, engineering skill has created a busy hive. All this has been made possible by the utilization of one of the largest direct-injection oil-engine installations in industrial service. The machinery about the mill is driven by electric motors, the power being generated by means of three eight-cylinder 800 horsepower engines, each connected to an electric generator. These engines use heavy fuel oil.



Resistant to cold

Effective Bumper for Motor Boats

THE accompanying illustration shows how a very effective bumper for motor boats may be built at shore landings. A number of pieces of fire hose are fastened to the edge of a timber six inches square, which in turn is held in front of a cross gangway by six bolts, each bolt passing through a spiral spring—the springs serving to absorb most of the shock when the boat strikes the six-inch timber. The ends of the cross gangway are attached to floats by means of chains. The floats are held in place by piles driven into the bottom. When the boat strikes the edge of the six-inch timber, the shock is partly absorbed by the pieces of fire-hose, the spiral springs and the slack in the chains. When the slack in the chains has been taken up, the drag is on the upright piles which act as springs, absorbing the final shock.

Bumper for motor boats

Reel retrieves key

Automatic Key Reel

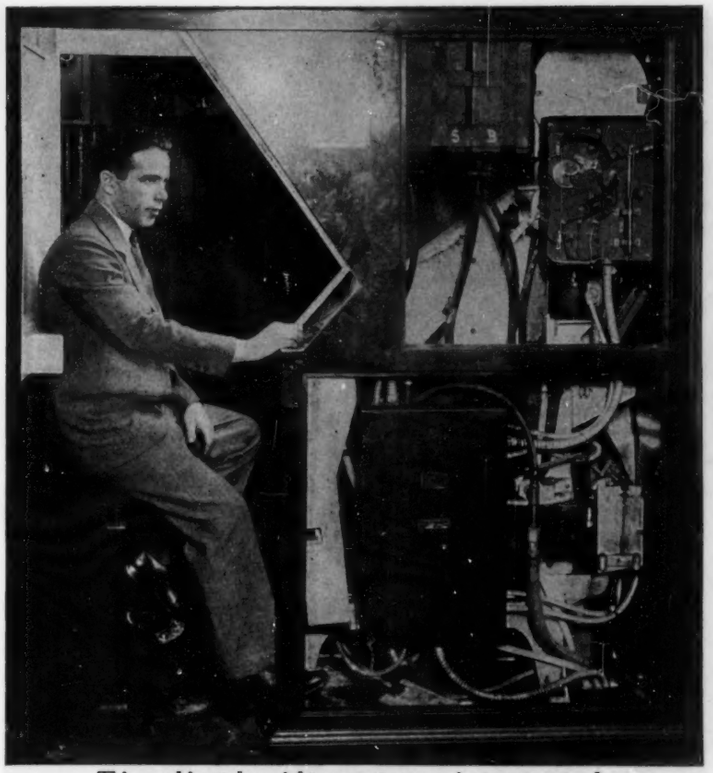
ONE can never leave his key in the door if he has this clever little device. It is really a key-ring reel attached to the belt. A coiled spring is enclosed in a metal case which has two spaces on the back through which the belt runs. The spring works like that in a spring tape measure only it winds up a small chain instead of a tape. When the key is released, the reel automatically retrieves it.

Eight Posed Pictures for a Quarter

THE "photomaton," as this machine is called, is an automatic camera enclosed in a cabinet. The photographs are taken directly on a strip of sensitized paper without the use of a film or plate. The device produces a strip of eight different poses of the person being photographed. It is only necessary to turn the head several times during the 20-second period while facing the camera. The pictures which are produced are very much like the "ping pong" photographs of a decade ago only they are larger.

The operation of the machine does not differ very much from that of any other coin-controlled machine, outside of the posing. The mechanism is necessarily complicated, but the various processes of photography which are generally accomplished manually are here rendered automatic by ingenious electrical and mechanical controls which synchronize and coordinate the various operations. The strip is developed, fixed, washed and dried and finally comes into the hands of the owner who is "waiting at the slot." The wait is just eight minutes. Our detail view shows the apparatus which controls the shutter. When the person is seated and looking at the camera, and a quarter is dropped into the slot, the light is switched on to illuminate the face and the camera begins to function. The first operation is for a mask to drop away from the lens so that the image may reach the sensitized paper when the shutter is opened. The cam shown controls the movement of opening and closing the shutter. While the shutter is closed, the strip moves forward, the shutter opens again and makes another exposure. This is not in any sense a motion picture but rather a succession of "stills."

Wooden strop and hone



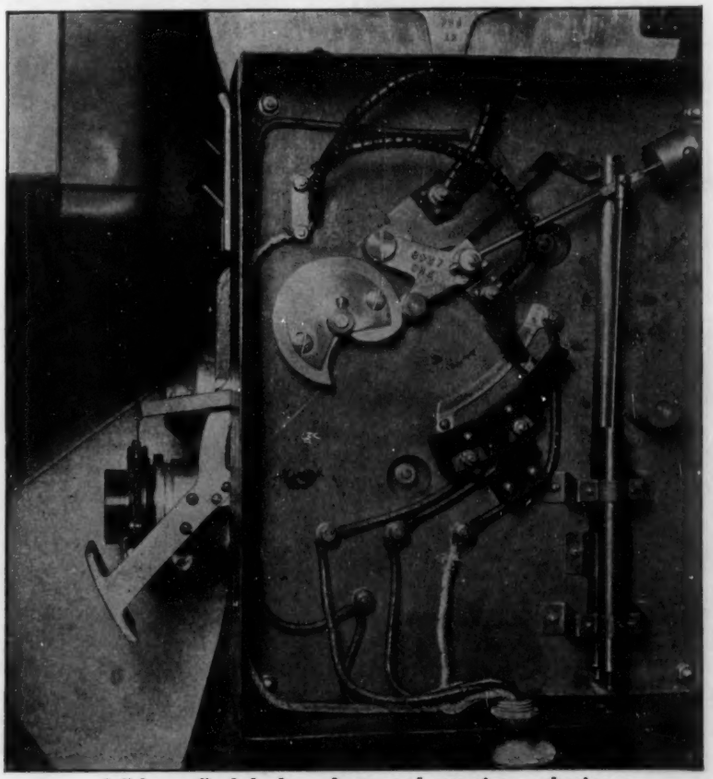
This machine takes eight separate poses in twenty seconds

The pictures have a number of uses, as for example, for commuter's tickets, passports, pistol licenses and railroad passes.

The machines are proving very popular and the inventor of the clever device, Mr. Anatol M. Josepho, kindly consented to pose for us.

A Wooden Razor Strop

WHEN we come to think of it, a leather strop is unsanitary and is more or less affected by weather changes. The device illustrated was invented by a barber who knows the needs of his profession. On the lower side is a hone and on the upper side is a wooden strop which is scored longitudinally, dividing the surface into parallel strips. This would hardly give enough resiliency, so the strips are supported only on both ends, allowing them to bend. The wooden strop is coated with a razor sharpening compound. There is an apparent slot beneath the surface of the wooden side. This is a gap caused by supporting the wood on each end so that wood "gives" like a leather strop.



A "close-up" of the lens, shutter and actuating mechanism

Using the "decelerometer"

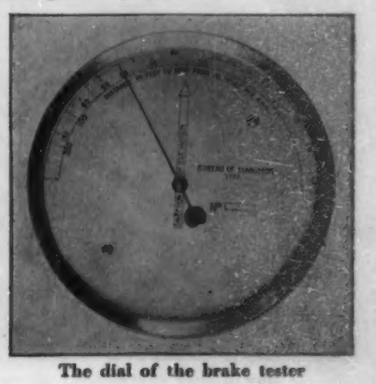
Testing Automobile Brakes

THE particular device for brake testing that is shown in these columns, is called the "decelerometer." Its operation is based upon the fundamental laws of motion. The instrument is cylindrical in form, as illustrated, and is about six inches in diameter and seven inches high. The dial is white with black letters. For specific brake testing campaigns, the dial can be marked in red at the maximum stopping distance allowed. All tests above the red line pass inspection, while all below are rejected and the car owners instructed to fix the brakes.

The instrument reads the force exerted by the brakes in terms of "feet to stop from twenty miles an hour." It makes no difference whether the car taking the test is going 15, 20 or 25 miles an hour; the instrument interprets the results as though the car were traveling at 20 miles an hour.

In making the test, the instrument is placed upon the floor or running board of the car with the arrow pointing toward the front. The car is accelerated to any desired speed and the brakes applied with as much force as possible. The pointer will indicate the equivalent stopping distance from 20 miles per hour and will remain there long enough for an accurate reading to be made.

Essentially, the mechanism consists of a pendulum hung on a horizontal shaft to which is fastened a bevel gear. Meshing with this gear is a bevel pinion mounted on a vertical shaft to the top of which is fastened the pointer of the instrument. The pendulum is damped by swinging it in a chamber of oil of suitable dimensions, the manufacturers having chosen an oil of suitable viscosity by experiment. The pendulum is geared to the pointer at a ratio of one to four and is free to swing forward and backward. When the brakes are applied, the pendulum swings forward by an amount proportional to the braking force. This device is used by automobile clubs and police departments.



The dial of the brake tester

Ready for the check

New Check Protector

THE photographs above and in the upper right-hand corner of this page show a check protector of plier-like construction that is easy to operate. In use, the check is inserted in a slot in one end of the device, a knurled knob is turned until the desired figure shows through a small opening in the top, and the handles are pressed. Upon release, the check is fed to the left, ready for the next impression. The numerals are stamped into the fabric of the check with acid-proof ink, and are practically unalterable.

Salvaging Bent Wires

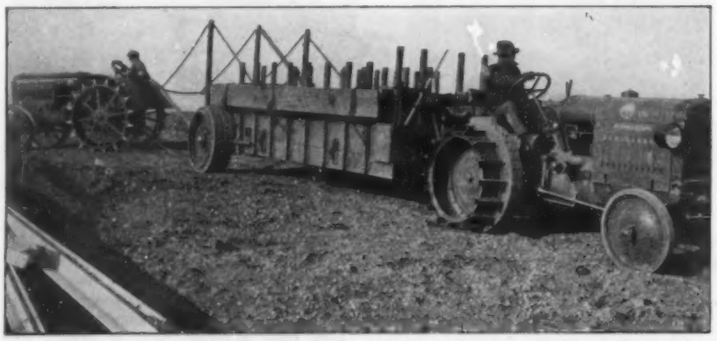
BENT core wires are a nuisance in any foundry and it often costs more to straighten them than it would to buy new wire. Now, however, there is a simple device on the market which straightens such wire very quickly. A feed guide directs the wire into a series of rolls. The first two act as pinching rolls; the remaining rolls are staggered. All but one upper roll are driven by gears. The machine which we show is an eight-roll straightener. Arrangements are made so that once the machine is adjusted it will not be necessary to readjust the rolls for each size wire, other than to raise or lower the last roll to correct the tendency of the wire to go up or down as it is delivered from the machine. With very little practice, an inexperienced man can operate this machine without any difficulty.

A Quick Unloading Method

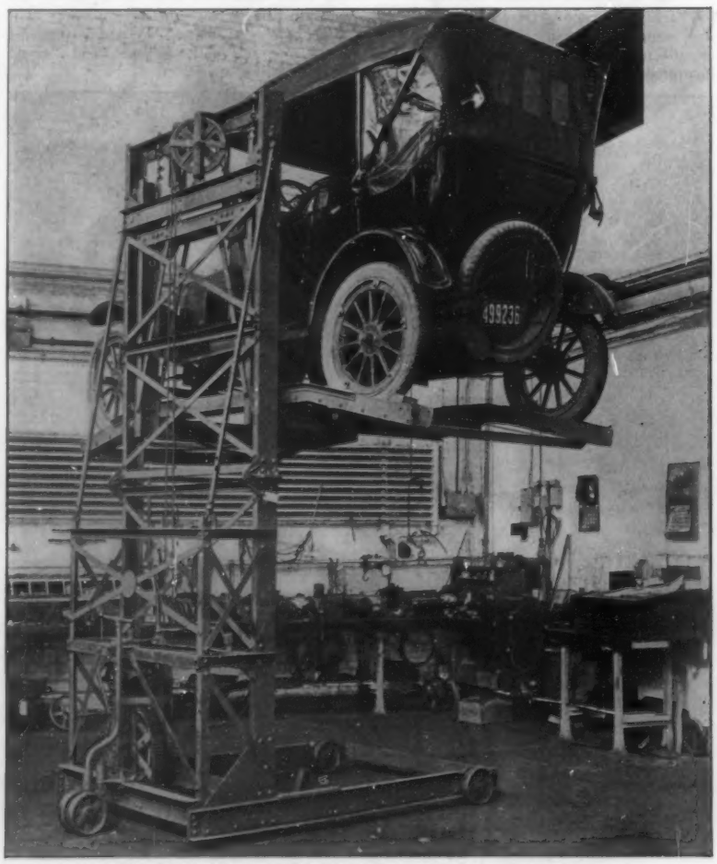
A QUICK and economical method of unloading steel—used in the construction of the towers of a power line in California—is shown in the accompanying illustration.

New fixture attachment

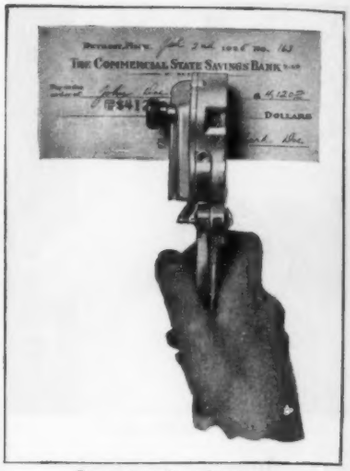
This machine will straighten 150 to 200 feet of wire per minute



How the tractor pulls a load of steel from the rear of the trailer



This portable elevator raises cars to a mezzanine floor



Stamping the character

A trailer was built with a removable partition down the center. Just enough steel was carried on each side of the partition to erect one tower. The steel rested on rollers in the bottom of the trailer, which enabled it to be rolled off like a load of lumber. When the tractor towing the trailer had reached the point where the tower was to be erected, a second tractor carrying a cable was backed up to the rear of the trailer and the cable attached to the steel in one of the compartments. Then the tractor moves forward and pulls the load off in less than a minute.

A Useful Outlet Box

USING a new idea for electrical outlet boxes, a greatly simplified method of installing light fixtures has been devised. It gets its name, "Base-O-Lite," from the fact that a lamp may be screwed directly into the outlet box to give temporary illumination, an advantage in a new building where there might be delay in getting other fixtures ready.

A Portable Car Elevator

AN automobile concern in Buffalo, New York, was considering the erection of another building or getting better use of the one occupied. A mezzanine floor was suggested and adopted. This necessitated that some means be provided for raising the automobiles to it and we illustrate the solution. The lift is hand-operated and is portable so that it serves the entire length of the mezzanine floor.

Shoe Protection

IT is often necessary for the housewife, after dressing for some social affair of the evening, to enter the kitchen and do some small job that may result in spattering her shoes or stockings. In such an event, the rubber "spats" will be found very useful.

Rubber spats for kitchen wear

The table ready for a meal

A Dual-purpose Table

MR. F. W. PLANT, of Birmingham, England, has invented an interesting table that can be used for two purposes. As is shown in the top center illustration on this page, it can be arranged in three tiers and pushed from the kitchen to the dining room in the same manner as a serving table. When brought to the desired location, the upper and lower sections can be brought to a level with the center one and the whole will serve as a standard table. All the manipulations are carried on with the dishes on the table. The lowering and raising mechanism is so designed that there is no danger of spilling any of the food.

An Indestructible Umbrella

AN umbrella which is practically indestructible and which can be opened by pulling a cord has been invented by the "lady Edison," Miss Beulah Louise Henry, a prolific inventor of useful devices which we have illustrated from time to time. The ribs of the umbrella are flat pieces of steel and they are so constructed that the covers can be easily substituted by removing the ribs from the eyelets. A pull of the cord serves to close the umbrella. The cord is made fast to a cleat on the handle. Miss Henry has invented other umbrellas, one with changeable covers which match the gown.

The bathing dog inflated

This convertible table can be used as a dinner wagon to carry in the dishes

A Canine Bathing Companion

THIS woolly dog will help those who are not adept at swimming. The dog can be carried to the beach deflated and then blown up by means of a rubber bulb which is located in the short stubby tail. The bladder within the dog will contain enough air to help sustain the average person. This is also one of Miss Henry's inventions. The toy furnishes much amusement, aside from the practical usage.

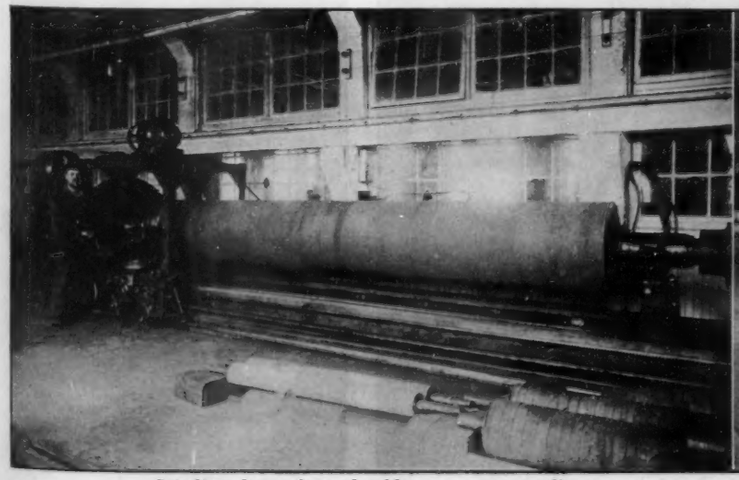
How Rubber-covered Rolls Are Made

A SHORT time ago, the writer visited a large rubber manufacturing company at Passaic, New Jersey, and was interested in seeing how rubber was applied to huge rollers and how they were afterwards machined. One of the most important and skillful applications of rubber to industrial purposes is that of rubber covered rolls of which the small clothes-wringer roll is a miniature example. Paper-press rolls sometimes have a 210-inch long rubber covering and weigh several tons. The rolls shown were made in England and weigh 11 tons each. The face measures 233 inches. The diameter when covered is 30½ inches. Two thousand four hundred pounds of rubber was required to cover them. The process of making rolls of all sizes is substantially as follows:

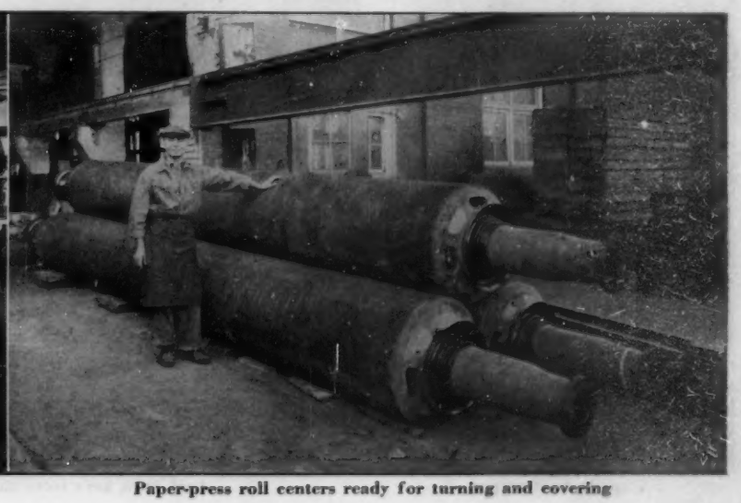
The cast iron center is brought to the rubber mill and the surface is roughened. A V-thread is cut on the roll and then flat grooves are planed across the threads, thus presenting a surface which will lock the rubber and iron against both circumferential and longitudinal movement. The roll is then washed with naphtha, heated with steam and scoured with wire brushes. The cover is built up from rubber sheets—the work being done by hand. Before curing, the face of the roll is covered with plies of wet sheeting, then cross-wrapped with narrow cloth. The roll is then transferred to the vulcanizer where it is slowly rotated to insure uniformity during the process of curing. When entirely cured, it is ground on a special lathe as shown in our illustration. This must be done very accurately. In a paper mill, the rolls are used at the "wet" end of the paper machine to extract the water from the freshly formed paper by compression between a granite roller and a rubber roller. Rubber rollers are used for many other industrial purposes. In tanning, they are used quite extensively in many of the operations such as fleshing, shaving, splitting, unhairing, wringing, et cetera. The textile industry calls for the use of rubber rollers and they are also in many of the industries allied to it such as bleaching, dyeing and mercerizing. According to the *India Rubber World*, rubber rollers are used for bean pickers, corn huskers, gluing machines, inking machines, paper box machines, sheet iron galvanizing, silk spinning and tobacco squeezing. The use of rubber rollers has developed an interesting side line for the rubber industry.

Furling the umbrella

Changing the cover



Grinding the surface of rubber paper-press rolls



Paper-press roll centers ready for turning and covering

The "snugger" automobile shoulder rest viewed from the side

Comfort in the Automobile

IN order to provide perfect ease for all automobile riders, the "snuggers" illustrated in these columns have been designed. These devices are so arranged that when they are in position, they provide side rests for the shoulders of the passengers and so prevent swaying when turning corners and at the same time enable perfect relaxation. The supports are completely adjustable so that a stout or a thin person can be accommodated without difficulty. When not in use, the "snuggers" are so arranged that they can be slid to one side or the other of the back of the seat and so be out of the way. As they travel on a toothed rack and are provided with locking handles, they will always stay in the position in which they are placed. One of our illustrations shows a side view of one of these devices in use and the other shows the mechanism.

The Electric Boot-black

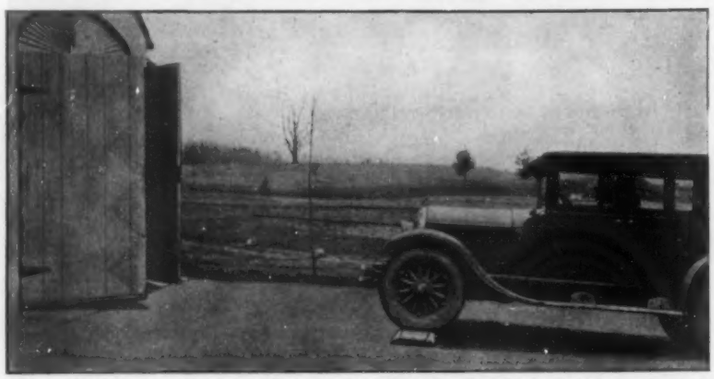
OUR illustration shows a boot-black stand operated by electricity. The foot-rests fold out of the way when the

A bed for invalids

process of shining is not going on so that the customer has easy access to the chair. A slight pull on the center handle brings the foot-rests into operating position and opens the brush drawer. The foot-rests are adjustable to four different heights. The brushes are driven by electric motors and connected to them by means of a flexible shaft. The brushes can be changed without stopping the motor. At the completion of the operation, a lever is lifted, the foot rests fold back, the drawer closes and the motor stops. This is all controlled automatically.

A spade bootscraper

An electrically operated shoe-shining stand. The brushes are driven by motors and may be changed without stopping the motor



When the wheel of the car rolls over the plate, an electric contact is made and the garage doors open

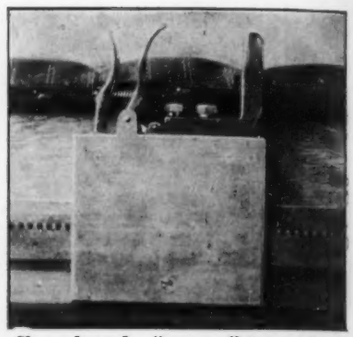
Automatic Garage Door Opener

YOU can now sit comfortably in your car and have the garage doors opened for you by the weight of the automobile in which you sit. This weight, applied to an iron plate in the driveway, operates an electric switch that either opens or closes as the owner of the garage wishes. The plate is self-draining as well as self-cleaning and is said to operate regardless of snow, ice, rain or mud. The device eliminates the necessity of leaving the car in inclement weather in order to open the doors.

Comfort for the Invalid

A CRIPPLE of Kansas City, Missouri, has invented an improved, adjustable bed adapted particularly for hospital and sanitarium use. It can be adjusted to eleven different positions by the use of various control wheels. With its use, the invalid always will be comfortable.

Lock-joint keys solve the knock-down problem



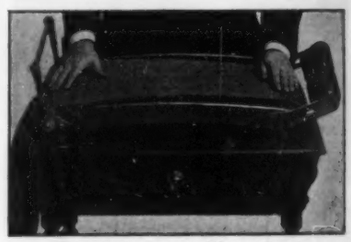
Shows how the "snugger" is attached to the back of the cushions

Simplified Clothes Pressing

THE baseboard of this device has a convex surface and our illustration shows the trousers being placed in position. The webbing shown in the roll at the right is then pulled across the garment, the pressure bar is depressed and in one minute, the pair of trousers is pressed.

Some English Boot Cleaners

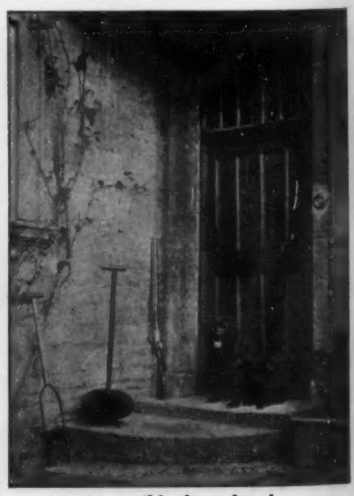
WE illustrate two English inventions for cleaning boots which are very efficient. The "spade" boot scraper is about the size and weight of an ordinary spade and enables the boot to be scraped clean all over without injury to the leather. It can be held at any convenient angle. The second device consists of a large boot brush which looks like a hedgehog.



Pressing pants without heat

Lock-Joint Keys

TO help solve the problem of making and assembling "knock-down building parts, lock-joint keys are now being marketed. Our photograph shows a router for cutting the dove-tail slots. The lock-joint keys are shown at the front of the bench. In practice, they are inserted in the wood, the parts are placed together and nailed.



A sensible boot brush

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

All the Comforts of Home for Telephone Toll-line Construction Men

MOTOR trucks have brought a complete change into the lives of telephone toll-line construction men of the Pacific Telephone and Telegraph Company on jobs away from centers of population of the Pacific northwest. No longer do they wonder, before starting out, where they will eat and sleep and what kind of accommodations they will find. Today, thanks to the automotive transportation, they have portable "hotels" that travel with them along the route.

Interior of the well-arranged bunk car. Accommodations are provided for eight men. Washing facilities and heat assure maximum comfort

Construction gangs which usually employ 20 to 25 men, are being supplied with their own bunk houses and cook outfits. These are mounted on trailers and hooked to a truck which moves five or six units at a time whenever required. In the past the men often had to ride 15 or 20 miles in going to work each day.

In the northwest where this equipment is in practical operation, the motor trains have worked out to the complete satisfaction of the owners and the men. This is evidenced by the fact that the labor turnover is far lower with this new arrangement.

In designing the sleeping cars, the company overlooked nothing that would add to the comfort of the men. Each car has eight large berths, washing facilities, a stove and gasoline lights. These offer sleeping accommodations that would be hard to improve upon when compared with the average small-town hotel.

The cook outfit also takes exceptional care of the workmen, because the company knows that their efficiency depends upon their health. A sample noon-time lunch includes mashed potatoes, creamed carrots, beef, string beans, home-made bread, real butter, coffee or tea and choice of pies or pudding. All this is at a saving to the company and is far better than in the old days when the men were forced to stop at roadside restaurants.

These motorized camp trains are speeding up the work of maintenance for the company and helping to keep the men contented.

Meal time! Well cooked food is supplied at a minimum of expense and with a saving in time

* * *

Shadowing Birds with Government Bird Detectives

FROM the banks of the Kennebec to those of the Niger in Africa! That is the journey accredited to a common tern by the Biological Survey of the United States Department of Agriculture, which is now receiving many interesting returns from the bird-banding work at one of its bird colonies in Lake Michigan last year.

With the growing public interest in this bird investigation the department has recently published a list of instructions concerning the practical significance of bird-banding, as well as some of its history. This form of bird identification dates from the time of Audubon, who about 1803 placed silver threads around the legs of a brood of phoebe birds and was rewarded the following season by having two of his marked birds return to nest in the same vicinity.

The earlier investigators, according to the recent report, marked their birds by dyeing or staining the flight or tail feathers, attaching memoranda written on parchment, or mutilating feathers, feet or bill. In this country active experimental work was begun in 1901, when aluminum bands were attached to the legs of the birds. The results were so satisfactory and stimulated so much interest that eight years later the American Bird Banding Association was organized in New York City.

Subsequent study has revealed that two principal lines of research must be given special attention. The first of these is the banding of fledglings; and the second, the systematic trapping and banding of adult birds. The latter work is the more significant because the older birds give the most information on bird habits.

Trapping is accomplished by various snares, one of the popular ones being the "government" sparrow trap, a funnel-shaped device that can be constructed by the amateur from parts that are easy to obtain. Others which the Department recommends are the well-known drop trap, the door of which is suspended until the unwary bird makes for the bait, when the door drops and shuts the victim in.

The Department, in order to be able to study the life histories of birds even more closely than heretofore, urgently requests the cooperation of naturalists whose casual discoveries of wayfaring band-bearing birds might be well worth reporting. In this way the governmental investigators expect to solve the many problems which previously have baffled the ornithologist. Among these are the speed with which individuals of any species may travel on their periodic migrations, the possible vanguard formed by one flock for other flocks, and the advance made by successive flocks passing one over the other (leap-frogging) in alternate periods of rest and flight.

Other questions which can be answered by bird-banding operations are: Do individual birds of any given species always follow the same route, and is the route the same for both spring and fall flights? Do migrating birds make the same stop-overs every year to feed? How long do birds remain in one locality during either the migration season, the breeding season or the winter season?

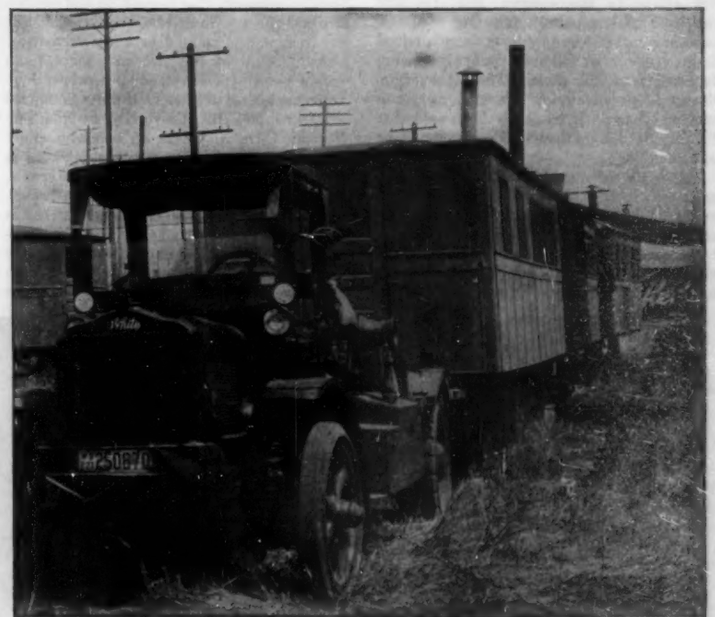
Other queries are: What is the relation between the breeding and the wintering grounds of individuals; that is, do those birds that breed farthest north winter farthest south, thus jumping over those that occupy the intermediate zone, or do they merely replace the latter individuals as winter residents? To what region do the birds go, particularly the young, that do not return to the vicinity of their original nests? Do birds adopt the same nesting area, nest site and winter quarters in successive seasons? During the rearing of how many broods will one pair remain mated, and which bird, if not both, is attracted next year to the old nesting site?—*New York Times.*

* * *

A New Source of Hydrogen

DURING a recent congress of industrial chemistry which was held in Bordeaux, France, it was announced that certain experiments carried out with oil shale had demonstrated that it was possible to obtain considerable hydrogen from this source. Autun shale, which is one of the principal shale deposits in France, was distilled in a closed vessel and was found to yield a gas which contained large quantities of hydrogen.

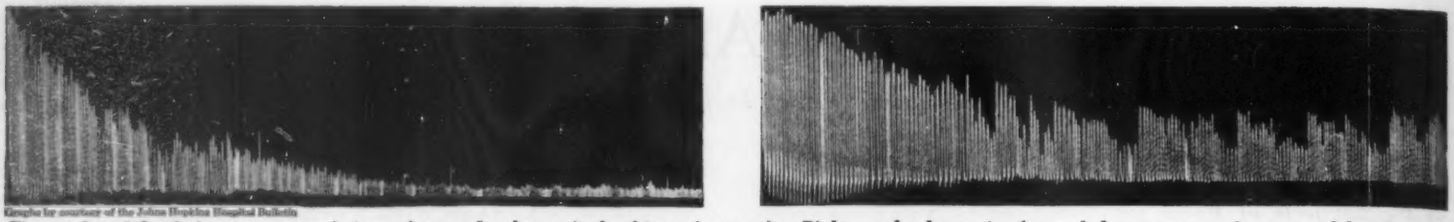
During the distillation of the shale, carbonaceous deposits were formed on the sides of the retort. This is a common occurrence in the distillation of all carbonaceous materials, and in order to remove these deposits, steam was introduced. The steam decomposed the carbon and it also resulted in the production of a water gas which contained a considerable proportion of hydrogen. It has been estimated that in a plant treating one hundred thousand tons of rock a year,



The bunk and dining cars hitched to the truck that tows them from place to place. The men are entirely independent of railroads and hotels

the production of hydrogen would be seventeen million cubic feet, from which it would, it is claimed, be possible to manufacture eight thousand five hundred tons of ammonia.

Hydrogen is a gas which is found in very small amounts in the uncombined condition of the air, but it exists in combined form in water and in other gases and chemical compounds that are found in the earth. This gas has important uses in the arts and sciences. It is still the most important gas



Graphs by courtesy of the Johns Hopkins Hospital Bulletin

Figures 1 and 2: *Left*—an average fatigue picture of unhypnotized subjects (see text). *Right*—under hypnosis, the work became more vigorous and lasted much longer (the last 3/7 of the graph, which was practically identical with the right hand half of Figure 2, was not reproduced, owing to limitations in space)

for inflating military and commercial balloons and airships, although its use for this purpose is attended with serious fire risk. Hydrogen is the substance that changes liquid food oils into solid fats. It affects hydrogenation of the oils. Thus, for example, by its action cotton-seed oil is converted into a snow-white fat. Furthermore, hydrogen is a very important product in the synthetic manufacture of ammonia from the atmosphere by the Haber process which was developed and used in Germany during the war.

Today hydrogen is made in a great variety of processes, the raw materials being either water or coal, or both, and sometimes metal and acid. It is also produced in the decomposition of steam by incandescent coke, coal or other carbonaceous matter, and is thus an ingredient of water gas. It may be made by the electrolytic decomposition of water, or by the action of acids on metals. The latter process is used for the production of hydrogen in the field when it is employed for military purposes, for inflating balloons.

The latest source of hydrogen is oil shale. Oil shale is a bituminous, sedimentary rock, which occurs in extremely vast quantities in Colorado, Utah and neigaboring states, as well as in Scotland, where its use for the production of mineral oil was first developed. It contains bituminous matter which may be distilled over to give an oil which possesses certain characteristics that are found in petroleum. At the present time the immense deposits of shale are not worked to any extent in this country, but after the depletion of our petroleum resources a certain amount of the products, now derived from crude oil, will no doubt be manufactured from oil shale. The oil-shale industry is practically a new and as yet a very small one. It has aptly been said that if "oil is king, then shale is the heir apparent."

Oil shale is mined much like ordinary rock and is then distilled in special apparatus. A variety of products is obtained, including not only oil and other tarry matters, but a fertilizing material of value, ammonia and an inflammable gas which possesses high heating value.

rigid form; still the individual does not flinch or even sag. Thus writes Maud De-Witt Pearl.

Who has not seen or at least heard of the pin-sticking stunt when an individual in a state of hypnotic slumber can complacently endure numerous punctures of his casing? Again there are the Trilby performances, in principle duplicated just as they were described in Du Maurier's fiction, which prove that some persons are able to do a great deal more in certain lines when in hypnosis than when in the normal state.

For a long time hypnotism has been chiefly a spectacular affair. The professional mesmerist has practiced his art to fill his pockets and has had little interest in the effect produced upon his subject. That a power which can produce such profound nervous and muscular changes in mankind has not hitherto been widely investigated by the scientist is remarkable. A few skilful physicians have used hypnosis with very good results in the treatment of nervous disorders, but until quite recently there has been no precise study by the experimental laboratory method to determine just what effect hypnotism has upon the body of an individual. And in order that the most beneficial therapeutic results be obtained it is highly important that such a basic investigation be made.

This need has been emphasized by physicians in searching for the best methods to treat nervous disorders arising from shell shock and other war causes where it has become apparent that hypnotism and suggestion are the two most efficacious methods in the treatment of these distressing ailments.

As a result of this necessity for a foundation upon which to conduct a proper hypnotic method of treatment there was started at Johns Hopkins University by the late Norman Clive Nicholson an extensive study to answer the following questions: "What is the condition of the muscular, the nervous, the cardio-respiratory, the gastro-intestinal, the endocrine and the excretory systems in the hypnotic sleep, and how can these systems be influenced by suggestion?" Put in simpler language this means that the investigator started to find out what effect the hypnotic sleep had upon a person's muscles, his heart, his digestion, his lungs, his brain and nerves, his kidneys, and his bodily organs and functions generally.

Only a preliminary report on certain phases of the experiments on the effect of hypnosis upon the muscular system was made public. These results, however, are as startling as one could wish for and have the added interest of opening the way to a great field in the treatment of stubborn nervous disturbances.

The method of experimental procedure was as follows: Individuals were first given a certain amount of work to perform when in the normal state. This work, namely, closing the middle finger upon the palm and thereby "lifting a known weight to a definite height" at regular intervals, is recorded by means of an "ergograph." This apparatus is so constructed that when attached in the proper way with straps and metal supports to an individual's arm it measures the amount of work that the muscles of the wiggling finger are doing. The record of the work as it is being performed is graphically set down upon a revolving drum by means of a needle point. Thus the investigator has an accurate picture of the muscle pull which the subject is able to exert at a given period of time.

At first the muscles perform with energy, although always after a few initial pulls the vigor begins to diminish. A weak pull is usually followed by several pulls of increasing strength. This increase is only temporary and usually the next pull of decreasing vigor is weaker than the previous slack pull. The net result is that the muscles do less and less work, and after a period of about ten minutes are unable to perform at all.

Figure 1 exhibits an average fatigue picture made upon the drum. This result was approximately the same for the seven individuals who were experimented upon. In order that a subject might repeat the same amount of work a rest period of from one to two hours, depending upon the person, was necessary. After establishing a definite record of the amount of work which each person was capable of performing in the awakened state by daily tests for a period of two weeks, the hypnotic experiments were commenced. The subject was placed in the deepest hypnotic sleep one hour after having performed the amount of work represented in Figure 1. Then he was directed to pull the weight again with his middle finger.

This time, however, the result was quite different from that obtained in the waking condition, as Figure 2 shows. Not only was the work much more vigorously performed, but it was continued for a much longer period. It was only brought to an end by the complete revolution of the drum, when there was no more space to record the movements. At this point the individual was awakened and after an interval of three minutes was again directed to perform the routine labor. This time the muscles acted as they did in the first test, becoming quickly fatigued.

From these three experiments we see that the individual performed in the hypnotic state a much greater amount of work than he was able to perform normally, and that almost immediately after the hypnotic sleep he was able to work with as much vigor as he would normally only after a rest period of from one to two hours. *The work performed while in the hypnotic state had no fatiguing effect upon the subject.*

Work was not permitted to cease, however, with the third experiment. Five minutes later the subject was hypnotized and again given his allotted task to perform. He willingly did his "stunt" and made nearly as good a record as in the first hypnotic test. When, towards the end of the experiment, the muscles did not act as vigorously as they did previously it was suggested by the investigator that the subject exert a little more strength. At once renewed energy was forthcoming.

The non-fatiguing effect of work performed when in the hypnotic state is again exhibited by individuals who, while working in an awakened state had almost reached the exhausted stage, were hypnotized. Immediately the amount of work increased as Figure 3 shows, and continued as long as there was any space upon the drum to record the results.

Suggestion to the individual laboring in the awakened state, when he had almost reached the point of exhaustion, that he improve his record had the effect of only slightly increasing the strength exerted. On the other hand, under the influence of the suggestion he was able to persevere a considerably longer time than he could if there was no such help given him.

It is to be hoped that the study of hypnotism will be carried to its utmost limits by scientists. Since it can be so usefully employed in the treatment of nervous troubles, why, in time, with a fuller understanding of how to use it, cannot hypnotism be used as a preventive? That is, says the author, why wait until the overworked business man has had a nervous breakdown to be treated by the hypnotic method? Why not call in the hypnotist when an additional amount of work is at hand to be done? With his assistance it should be possible to accomplish a far greater amount within a given time with much less fatigue than unaided. Then the overstraining of the nervous system would be avoided and the wearisome task of regaining lost health unnecessary, says the author.

Perhaps its use could be carried so far as to prove a cure for diminished production and shortened hours of labor. Would not one be quite willing to labor harder and for longer periods of time if, unconsciously and without fatigue, one could do so? Perhaps industrial plants will in time have attached to their staffs trained hypnotists who will spur the laborers on by their suggestive powers.

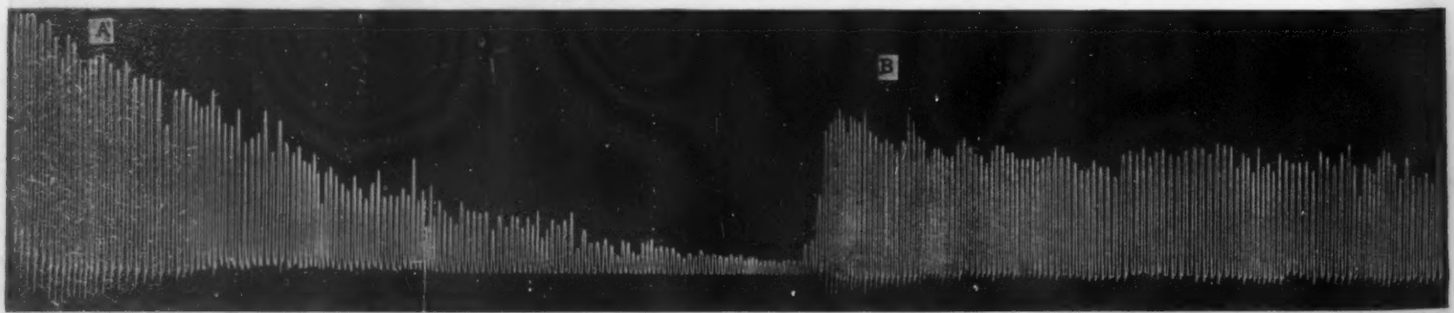


Figure 3: The first portion, A, of this graph represents work performed to exhaustion without hypnosis, but at B the subject was hypnotized, after which the amount of work accomplished rose to a much higher level and remained for an indefinite period

Hypnotism for the Weary

MUCH have we marveled at the ability of the hypnotized individual to perform and endure. In suspense we have watched the professional mesmerist by his mysterious power throw a person into a state of rigidity. The victim lies in mid-air in a horizontal position after the manner of a board with only a prop under each end. Various weights are then placed upon his abdomen, which he supports with the greatest apparent ease. Then the hypnotist himself stands upon the

Our Cover Design

THIS month the motif for our cover design is a French motor vehicle called the "monotrace." From the Parisian journal, *L'Illustration* we translate the following description:

"This very curious mechanism presents the essential peculiarity that it has two wheels but possesses four; and that, nevertheless, it never rolls on a maximum of more than three! It is a vehicle having two seats in tandem, a two-cylinder, water-cooled engine, a clutch, and three speeds. It consumes four liters of gasoline per 100 kilometers, while maintaining a speed of 80 to 90 kilometers an hour. [One gallon for about 55 miles, at 50 to 55 miles per hour.—Editor.]

"The two side wheels of this motorcycle are mounted on a beam which the rider is able, by means of a lever, to raise or lower to the desired extent. When the beam is entirely lowered the vehicle comes to rest on one of the little wheels, but never on both at one time. It is the same when the rider, feeling himself in danger on slippery ground lowers the beam in order to apply one or the other of the supporting wheels to the road; and the same is true when the vehicle is turned in a very small radius."

* * *

Energy-Velocity, an Answer

"WHEN the Chicago-Cincinnati-Pittsburg Limited crashed into the stationary Pittsburg-Washington Express, in Pennsylvania on June 17, killing some 15 passengers, the two heavy locomotives of the moving train, backed up by nine Pullmans, telescoped three steel sleeping cars their full length . . . ."

"How does the energy delivered by this heavy train moving at 50 miles per hour compare with that of the shell of a sixteen-inch United States Naval gun, striking at a velocity of 2,800 feet per second, assuming the train to weigh 1,200 tons and the projectile 2,100 pounds."

When reading the Scientific American for August, W. Frank Sutherland of Toronto, Ontario, made his off-hand guess, roughly comparing the two sets of data and also figuring that they must be somewhat comparable, for otherwise the editor would not have set them side by side for comparison. This done, the slide-rule and pencil were requisitioned and by the aid of the old familiar formula, energy=$MV^2/2g$, the results of 200,400,000 foot-pounds and 256,000,000 foot-pounds were obtained, for train and projectile, respectively. The figures are of the same order of magnitude, the much higher velocity of the shell giving it somewhat the advantage over the slower moving train.

However, the story is only about half told, for, prompted by curiosity, an endeavor was made to see what other sources of energy were available for comparison, besides the kinetic energy of the moving bodies. The shell itself of course contains an explosive, while as everyone knows, the locomotive boilers are capable of considerable destructive effort if ruptured at the instant of impact. The vast amount of the energy contained within the boilers is, however, totally unsuspected by the layman, who little realizes that the two locomotives of the train under consideration are the equal in energy content not alone of one but of several sixteen-inch shells. Let us see how this comes about.

Whenever any body is at a temperature higher than its surroundings, it has a potential capacity for doing work if the proper sort of mechanism is at hand. If we take a pound of water at 62 degrees, Fahrenheit, and raise its temperature one degree we have stored up within it one British thermal unit of heat, a quantity sufficient, if all were converted into mechanical effort, to raise the pound of water 777.5 feet into the air. In other words, one British thermal unit is equal to 777.5 foot-pounds of energy.

Under normal atmospheric pressure, water boils at 212 degrees, Fahrenheit; as the pressure is increased, the boiling point rises until at say 200 pounds on the gage, a common pressure in locomotive boilers, it is reached only at 388 degrees, Fahrenheit. The heat stored up in the water from the latter temperature down to the boiling point at atmospheric pressure amounts to about 181.4 British thermal units per pound.

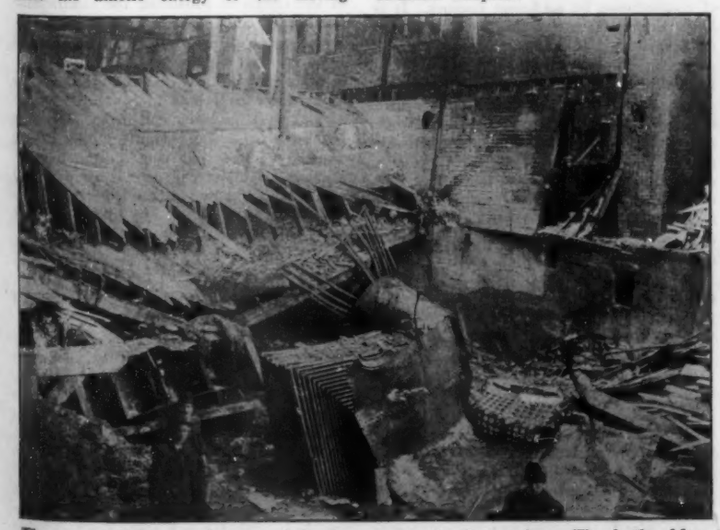
At the instant of rupture of the boiler shell, part of this heat is available for the doing of external work. A portion of the water is almost instantly converted into steam with explosive violence; the remainder having thus rid itself of excessive heat content, drops back to 212 degrees, Fahrenheit. In the ordinary course of events the steam generated in the boiler does work in the locomotive cylinders, but here the immense volume of steam thus suddenly generated acts much the same as the gases resulting from the detonation of an explosive. The steam contained in the boiler above the water level also contributes its quota towards making the work of destruction complete.

This wreckage was occasioned by firing the boiler of a home-heating plant and generating steam while the valves were closed. Such boilers are designed to withstand low pressures, only. Thus is the destructive force of steam illustrated

The steam escaping from a boiler explosion is as much subject to the laws of thermodynamics as is the steam quietly flowing through a locomotive cylinder. In both cases work is done by virtue of the temperature difference between the steam in its initial and final states, and in both cases not all of the heat added is available for doing external work. By the aid of steam tables, et cetera, the net amount available can be readily worked out, and in this case, assuming an initial pressure of 200 pounds, approximately 20.54 British thermal units are released per pound of water, doing about 15,972 foot-pounds of work. One pound of steel in the shell possesses 121,900 foot-pounds of kinetic energy or slightly less than eight times as much.

So, then, we might say that 2,100 pounds of shell at 2800 feet per second, 3,072,000 pounds of train at 50 miles per hour and 16,000 pounds of water at 200 pounds pressure in a boiler all possess about the same potential destructive energy. The photographs show the enormous force that can be exerted by the explosion of a steam boiler.

The "monotrace" might be termed a cross between a motorcycle and an automobile. The small wheels on the sides prevent falling when turning corners



The cause of this wreck was a defective gage and safety valve. The boiler blew up. It would take a good sized shell to equal this destruction

* * *

Three New Books

THIS world is too full of books. They accumulate faster than one can read them. Therefore we read only those that are believed to have merit. This will account for the fact that our reactions to most books mentioned in these columns may seem to our readers almost too invariably favorable. Our opinions of three more books follow:

"The Mammoth and Mammoth Hunting in North-East Siberia," by Bassett Digby, F. R. G. S., (D. Appleton and Co., New York), is a bright, rather lively, entertaining treatment of a romantic subject. One-third of the ivory of commerce, it is said by one authority, is fossil ivory from Siberia. That means that it is probably more than 10,000 years old. During the Glacial Period mammoths by the thousands bogged down in the tundras of Siberia, and the hunt for their remains, accidentally exposed by gradual thawing and river erosion, is now a regular "industry" of that great region. Digby's book is both scientific and narrative in nature. Some of the chapter headings are: "Puzzling it Out;" "The Mammoth and his Ancestors;" "The Mystery of the Mammoth's Extinction;" "Where Flesh-and-Blood Mammoths and Woolly Rhinoceroses are Found;" "The Ivory Isles;" "Tusks;" "The Great Mammoth Hoax." We learned much from this book. We enjoyed it as well. Its author is a professional hunter of fossil ivory.

Fath's "Elements of Astronomy" (McGraw-Hill Book Co., New York) is a remarkable book. At first glance it appears to be simply another textbook of astronomy. On careful reading, this treatise, just published, turns out, in our opinion, to be by far the most lucid treatment of astronomy for the beginner that has appeared since the publication of Todd's "New Astronomy," many years ago. Prof. Fath gives instruction in astronomy at Carleton College, Northfield, Minnesota. He is also Associate Editor of *Popular Astronomy* which is published at Carleton College. Evidently he has applied his experience in teaching directly to his new textbook, for we find evidence, time after time, that it has been worded especially to fit the perplexed state of mind of the beginning student. In case after case astronomical matters that have been written about by various writers without much apparent success are cleared up by Fath in a sentence or two. He seems to scent the kernel of the difficulty that perplexes the beginner and goes straight after it.

Another point in favor of this text is its modernness—it brings the science of astronomy right up to the year 1926. The treatment is elementary, yet, contradictory as the statement may seem, the major problems of the newer astronomy are not on that account dodged. Thus we find a clear, elementary treatment of such things as the Einstein theory as applied to astronomy; the radiation of the sun's mass into energy; cosmologies new and old; the period-luminosity law; and the like. The book is not long—273 pages—it is excellently illustrated and affords the best foundation on which the would-be amateur astronomer can build—that is, a frank text-book treatment, but one of the more interesting, modern type.

Another text-book of the same sort, although about a different subject, is Tarr and Von Engeln's "New Physical Geography" (The Macmillan Co., New York). This is a new, revised edition of its noted prototype written by the late Prof. R. S. Tarr. There are plenty of textbooks of physical geography but this one is somewhat unusual and has had an unusually wide de-

mand for years. Its authors have done with physical geography just what Prof. Fath has done with astronomy. That is, they have made it really interesting instead of a dry textbook grind. If one wishes merely to be entertained there are, of course, numerous books on earth phenomena which will, possibly, require less expenditure of brain energy. If, on the other hand, one desires a well-rounded knowledge of the subject and perhaps a trifle less pure entertainment, there is no better source from which to get it than a high-school, or preferably for our readers, a college textbook. And modern textbooks *are* interesting, unlike most of their forbears which were (purposely?) dry. Uninteresting textbooks do not last long these days: there are too many available that are not dull.

* * *

Rays, and Rays

EVER since the newspapers and the technical press recently published descriptive articles concerning the new cathode-ray tube invented by Dr. Coolidge there has been a puzzle in the mind of the layman. "Here," he complains, "are what you call cathode 'rays,' yet they turn out to be streams of particles or flying electrons; and here are what you call X rays which do not seem to be particles at all, but are waves of the nature of visible light, only with about ten thousand times higher frequency. How can the physicist logically characterize these two distinct categories of things—one a particle, the other a *wave* of some intangible nature —by the same word, that is, 'rays.'"?

The answer, of course, is that they should not logically be designated by the same word. The whole confusion, then, boils down to a mere matter of word usage. Had the science of physics been planned ahead, and been developed by one mind, it is likely that two separate words would have been used to denote these two separate kinds of entities, and much of the confusion that now exists in the lay mind concerning the actual nature of X rays, cathode rays, gamma rays, cosmic rays, alpha rays and several other rays would never have arisen. But it was not. Its terminology is a gradual up-growth.

To clarify this situation, a nut-shell treatment extracted from the article by the noted Professor Soddy, entitled "Rays," and published in the new, three-volume addition to the Eleventh Edition of the Encyclopædia Britannica suffices better than any quotation we have so far found:

> *Rays, Old and New.*—The subject of rays divides itself naturally into the old and the new. The older known rays are all of the one type, being electromagnetic rays traveling through empty space radially outward from the source at the uniform speed of light, 185,000 miles (or 3×10^{10} centimeters) per second. Some of the more recently discovered rays are of the same type as light, with either very much longer waves and lower frequencies—the Hertzian waves—or very much shorter waves and higher frequencies—Röntgen or X rays, the *gamma* rays of radium and the most recent of all, which may be termed Millikan rays. Others of the newer rays—the *alpha* and *beta* rays of radioactive substances and the cathode rays and positive rays of the vacuum tube, are not waves at all but radiant particles carrying an electric charge. When the radiated particle is a negative electron, as is the case for the cathode and *beta* rays, it generates rays of the first or wave type on impact with matter, much as a stone thrown into water generates waves in the water. The relation, however, as is so often the case with electrical phenomena, is reciprocal, and electromagnetic waves will liberate electrons from (that is, "ionise") the atoms of matter in their path, and these liberated electrons may, under suitable conditions, act as cathode rays. The *alpha* rays consist of the flight of atoms of helium, carrying two positive charges, and the only justification for calling them *alpha* rays as well as *alpha* particles, both terms being in use, is that they are propagated radially from their source. The positive rays, similarly, are positively charged atoms, and like cathode rays generated inside vacuum tubes, they follow the lines of electric force in the tube. So for these there is not even this justification for calling them rays. The most consistent definition of the term "ray" would perhaps be any carrier of physical energy across empty space, but this would include a meteor and exclude a sound wave.

* * *

"The Year Without a Summer"

THAT it is risky to judge the value of any one particular method of long-range weather prediction from local conditions, or even those which may obtain over a large section of the country, is well shown by a brief study of one of the monthly temperature maps published in the *Monthly Weather Review*, issued by the United States Weather Bureau, one of which is reproduced in these columns. Each month this journal, which is of a technical nature intended for the serious student of meteorology, publishes a detailed meteorological study of the month previous but one.

Courtesy of "The Monthly Weather Review"

While the east shivered, last June, the west roasted. This weather map enables one to grasp the nation's weather as a whole, instead of locally

From the mean temperature departure chart for the month of June it is obvious that, while the east believed that month to be excessively cold, and feared that the prediction of a well-known amateur "long range" weather prophet—that 1926 was likely to be a "year without a summer"—might prove only too true, the west was experiencing a corresponding excess of temperature.

In the map these facts are shown. The dark, ruled area is that over which there was a surplus of temperature. Within this area the curves indicate the extent of the excess. The border curve represents "zero" excess (that is, normal temperature). The adjoining curves represent two, four, six and eight degrees excess, respectively. Thus, in western Nevada there was an average excess of eight degrees of temperature, as a monthly average for June.

Similarly, east of the excess area the curves represent average temperature deficiencies up to six degrees. For example, the belt of states lying between Virginia and Iowa experienced an average temperature deficiency of from two to four degrees, Fahrenheit.

From month to month we see these maps, and the one shown is not especially unusual in the respects dealt with above. Taking the country as a whole there has been no marked evidence that 1926 was "a year without a summer."

The *Monthly Weather Review* for August summarizes the nation-wide weather conditions for the combined months of June, July and August as follows:

"For the summer, as a whole, the temperature was remarkably uniform, and was slightly above normal over much the greater portion of the country. The seasonal average was one degree to three degrees below normal in most sections from the Ohio Valley and Middle Atlantic States northward, and one degree below at about half the stations in the Gulf area. In all other sections the temperature averaged from normal to as much as six degrees above, the greatest plus departures being in the more western States.

* * *

Chemists Believe Future Fuel Problems Can Be Met

WHEN there is one motor car to every four persons in the United States, which is now estimated as the saturation point in motor-mad America, and oil wells stop producing, what will America do for "gas"? At the last meeting of the American Chemical Society, many schemes are suggested for keeping the wolf from the garage door.

"The United States had 100,000 motor cars 20 years ago, and today she has nearly 20,000,000," Dr. A. C. Fieldner, chief chemist of the Pittsburgh department of the United States Bureau of Mines explained. "The United States own five-sixths of all the motor cars and trucks in the world, and uses 80 percent of all the motor fuel. Nearly all of this motor fuel is gasoline made from petroleum, and the petroleum supply in the United States is definitely limited."

The engines of motor cars, Dr. Fieldner said, are very inefficient users of fuel. The mileage could be almost doubled if engines of greater gas compression were used with anti-knock gasoline, and the supply of petroleum could be made to last some years longer.

The oil wells of proved acreage in the United States are estimated to contain five billion barrels of readily available petroleum, and this supply would last only until 1936, Dr. Fieldner explained, at the present rate of consumption by inefficient engines. It is believed that more than five times as much oil or about 26 billion barrels may still be gotten out of the wells when ordinary pumping is finished. In addition to this, oil-shale deposits, soft coal and lignite can supply about 700 billion barrels more when needed, according to the estimates of experts. This would make a total oil reserve of 734 billion barrels, which sounds enormous, but only about 4 percent of it comes from crude oil which is readily available and from which all the gasoline of commerce is made.

Gasoline used to be distilled from crude oil, but as the demand leaped with the growth of the motor car other means were used to swell the amount. A process called "cracking" was resorted to, and in 1925 petroleum yielded 35 percent gasoline. This is a high mark, but it is expected to be far surpassed in the future. An increase to a 55 percent yield, Dr. Fieldner said, would stretch the five billion barrels enough to make them last until 1943 instead of 1936.

The potential gasoline source of the future lies in cracking heavy oils into just two products, gasoline and coke, in one operation, according to Dr. Gustave Egloff of Chicago. Instead of a 35 percent yield in ten years it will be economically necessary to get 75 percent, he believes.

Not only does the cracking process increase the gasoline yield of crude oil, but it also provides the gasoline with the sought-for anti-knock quality. This is because of the high percentage of certain kinds of unsaturated carbohydrates called olefines that are found in it. Formerly, gasoline consisting of saturated compounds was in great demand and sold at a premium, but now it is doctored with anti-knock substances or blended with cracked gasoline before it is sold to the consumer.

The amount of cracked gasoline is continually increasing and can be used with motors of higher compressibility than ordinary gasoline, and a greater mileage can be obtained. The present average compressibility of all engine models in the United States is a little more than 4 to 1, but the best anti-knock cracked gasoline is suitable for a 5½ to 1 compressibility. Dr. Fieldner believes that the automobile manufacturers will gradually modify the engines as the character of the gasoline changes, and the resulting efficiency will save fuel and make the supply last the longer. It will increase the pleasure of the motorist by the smoothness and noiselessness of the motor and save him money as well.

When it becomes necessary, Dr. Fieldner said, the gasoline supply will be augmented by alcohol from the fermentation of vegetable matter as well as from its synthesis from coal and oil gases. Ultimately, however, oil shale, soft coal and lignite must become the source of automotive fuels. Oil distilled from shale will be cracked into gasoline and other products, while coal and lignite will be carbonized into solid and liquid fuels and other by-products. New liquid combustible materials, other than alcohol, may be synthesized from combustible coal gases.

Recovery of oil shale in the United States would yield billions of barrels of oil. This oil when cracked would yield the highest grade anti-knock gasoline, which would be greatly superior to that from tar oils from coal, because it would be free from objectionable acids.

Motor fuels from coal may be obtained in a variety of ways in the future. At Mannheim in Germany, coal and lignite are completely gasified, and methanol, synthol and other liquid combustibles are synthesized from it. In France, ethyl alcohol is made from coal gas. Ethylene, a by-product of the coke ovens, is converted into alcohol by the sulphuric acid method. If this method were applied in the United States the increase of motor fuel yields from coke plants could be pushed up to 65 percent. Ethylene from cracking stills and from oil-shale plants could also be made into alcohol.

If liquid fuel becomes very scarce in spite of the efforts of scientists, the electric storage battery may come back into use as motive power, especially if the long delayed discovery of a light-weight battery is made. Another possibility is that the use of a coal-dust motor may come into vogue. Experimental work is being conducted with some success by German manufacturers on the Diesel engine using coal dust. In fact, Diesel's original idea was to use powdered coal fuel, and after all these years, this expedient may become a solution.—*Science Service.*

* * *

Adding Length and Width to a Nile Steamer

IN the endeavor to increase the capacity of a steamship, it has been a not uncommon practice to cut the ship apart transversely, near the center of its length, pull the two halves apart and enclose the gap thus formed with framing and plating corresponding to that of the original vessel. In the accompanying illustrations, the ship was not only cut transversely and lengthened in the manner above described, but it was also cut longitudinally, and after the two halves had been drawn apart to give the desired

increase of width the gap was filled in with framing and plating corresponding to the original scantling.

This interesting job was done on a stern-wheel steamer, the *Luxor*, employed in the Cook's tourist service on the Nile—the work being carried out at Messrs. Cook's Engine Works, Cairo, by their superintending engineer—Mr. Thomas Reynolds. The *Luxor* was originally 130 feet long, 21 feet 6 inches beam and 4 feet 3 inches moulded depth. Her displacement on a draft of 3 feet was 163 tons. She was driven by a compound engine, cylinders 17 inches and 34 inches in diameter with a common stroke of 48 inches. The engine drove a sternwheel, 13 feet in mean diameter. Using steam at a pressure of 160 pounds per square inch, with the engines making 23 revolutions per minute, the speed of the *Luxor* was 9 miles per hour. She ran between Luxor and Assouan and had accommodations for 27 passengers.

Now the engine power was in excess of requirements and hence, on account of the demand for increased accommodations, it

The vessel cut and opened out; a view from the forward end

was decided to make a considerable enlargement of the boat—the plans providing for increased accommodations for 44 passengers —12 of which were to be carried in *de luxe* cabins with separate bathrooms.

In the new plans, the length of the vessel was increased by 29 feet and the breadth by 5 feet 6 inches—the new dimensions being 159 feet over all, 27 feet beam, and the new displacement, on the same draft of 3 feet, 264 tons. The old sternwheel, which extended entirely across the stern of the boat, was reconstructed to form two wheels of the feathering type with a mean diameter of 11 feet. A central bearing was fitted between the two wheels.

On trial, it was found that the reconstructed motive power gave the larger vessel a speed of 9 miles per hour at 29 revolutions per minute, using the original engine and boiler. The work of reconstruction was done on a floating dock between March 24th and July 9th. The vessel was cut athwartships aft of the boiler space, the two halves were drawn apart and the gap was built in as above described.

When the framing and plating of this longitudinal addition was completed, the vessel was cut in two in a fore-and-aft direction, a little to one side of the keel—the cut being made as closely as possible to the central axis except near the boiler which was left in position until the bottom plating was completed, when it was moved over 2 feet 9 inches to bring it on the exact centerline of the boat.

To open up the central gap after cutting through the hull, launching ways were attached to the dock and the fore half of the vessel was pulled forward by means of hand winches. After the longitudinal cut had been made and the two halves pulled apart laterally it was necessary to build a new bow. The engines were maintained in their original position astern against the port and starboard sides of the vessel. They were not dismounted during the alterations, but a new crankshaft was made to match the increased beam and the rebuilt sternwheel of the boat.

It will be noticed from the photographs of the completed vessel that, in order to obtain the necessary space for the extra cabins, an additional deck was added. There was also room in the enlarged vessel for a spacious dining room on the main deck, a drawing room and smoking room on the upper deck and an observation saloon on the promenade deck. The reconstructed vessel, renamed the *Delta*, easily maintains the speed of 9 miles per hour which is necessary to carry out the schedules of her trips up and down the Nile.

* * *

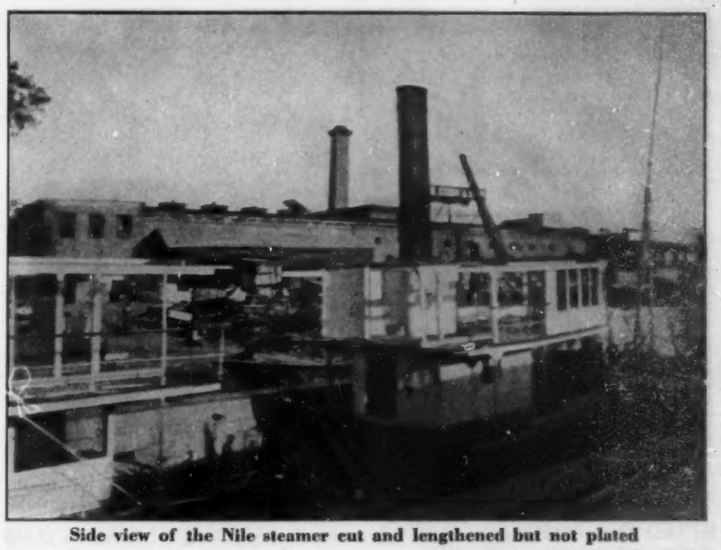
Anti-Freeze Mixtures Recommended for Autos

Now that the temperature is likely to drop below the freezing point, automobile radiators must be protected by filling them with some solution that stays liquid when water has changed to ice.

"What should be used?" is a question that science can more easily answer this year than heretofore. Denatured alcohol, or its poisonous brother, methanol (wood alcohol), will continue to be the usual and most common anti-freeze agent this year. Alcohol is cheap, effective and easily obtainable, but it has the disadvantage of evaporating and needing frequent replenishing.

Glycerine will also be a favorite. For all who drive cars painted with duco or other cellulose lacquers, glycerine is practically

The enlarged vessel once more afloat on the Nile



Side view of the Nile steamer cut and lengthened but not plated

a necessity, for alcohol dissolves this new sort of finish, and even a small amount of alcohol radiator solution spilled on the paint is likely to ruin it. Glycerine is more expensive than alcohol but it does not evaporate very readily and one filling of the radiator should last a whole winter season if the radiator is free from leaks. Either the colorless chemically pure glycerine or the yellow distilled commercial grade can be used with safety, but the crude product is dangerous because it usually contains salts that corrode the radiator.

When placing either alcohol or glycerine in the radiator, do not fill it above two inches from the top of the overflow pipe, since the solution will expand when the radiator warms up.

Denatured alcohol is preferable to wood alcohol in spite of the fact that 10 percent less wood alcohol is required for protection against freezing at any given temperature. Wood alcohol often contains free acids which will damage the radiator and the fumes, due to its poisonous character, may be harmful.

A little-known chemical, ethylene glycol, which like alcohol and glycerine is one of the chemical group of alcohols, is being heralded in chemical circles as an almost ideal radiator anti-freeze material. This chemical is used in the manufacture of duco and other lacquer automobile finishes and the available supply is largely utilized in this way. Glycol does not evaporate readily, it lowers the freezing point more effectively than alcohol, and it is non-corrosive. Its cost is about that of glycerine and when it is available in sufficient quantity it should be widely used.

Many other radiator solutions have been widely exploited and tested but all of them are objectionable for some reason:

Salts, like calcium chloride, magnesium chloride, common salt, et cetera.—Solutions of salts are corrosive and practically sure to cause serious damage to engine jacket or radiator. They are particularly harmful to aluminum and solder. Calcium chloride solutions are often troublesome if they come in contact with spark plugs and electrical connections as they cause short circuits. Both calcium and magnesium chloride solutions have been widely sold under trade names.

Sugars, such as honey, invert sugar and glucose.—Although honey has been recommended as an anti-freeze agent, tests at the United States Bureau of Standards show that low percentage mixtures do not have sufficiently low freezing points and that high percentage mixtures are so viscous that they circulate very slowly, if at all. Invert sugar acts about like honey and glucose is of even less effect than honey.

Oils—Lubricating oil is used in some cooling systems on tractors. It is not suitable for use in ordinary automobiles, for oil cooling systems must be especially designed to give more rapid circulation to compensate for the low heat capacity and the high viscosity of oil. Kerosene can be used in automobile cooling systems which are provided with mechanical circulation but the odor and inflammability of its vapor, the possibility of overheating due to high boiling point, and its solvent action on rubber are objections to its use.

The list below, based upon Bureau of Standards tests, gives the proper amounts of the various safe anti-freeze chemicals that should be placed in radiator water to protect at the temperatures indicated.

Freezing Temperature, Fahrenheit	Percentage, by volume, in water — Denatured Alcohol	Wood Alcohol	Distilled Glycerine	Ethylene Glycol
20 degrees	19 percent	12 percent	22 percent	16 percent
10 degrees	30 percent	20 percent	32 percent	25 percent
0 degree	38 percent	29 percent	40 percent	32 percent
−10 degrees	45 percent	34 percent	47 percent	39 percent
−20 degrees	52 percent	40 percent	54 percent	44 percent

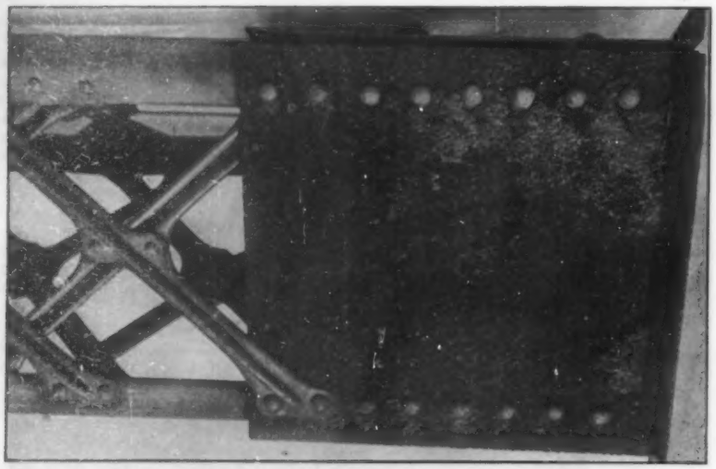
Example: If denatured alcohol is used, minimum temperature is 20 degrees and the radiator holds 3½ gallons, the radiator solution must contain 19 percent alcohol, that is, about one-fifth of it by volume. Proper solution can be made by adding one-fifth of 3½ gallons, a little more than 5½ pints, of alcohol to 11 quarts of water.—*Science Service.*

* * *

Duralumin as a Structural Material

THE class of aluminum alloys, known collectively as "duralumin," came into prominence in America about five years ago. It is a metal combining the lightness of aluminum with the strength of mild steel, and having great freedom from deterioration through rust and corrosion. Duralumin is rapidly becoming so important that engineers should be, but rarely are, as familiar with its properties, its merits and limitations, as with those of steel. It is the purpose of this article to set forth briefly the salient facts regarding duralumin as a structural material, says its author, C. P. Burgess, of the United States Bureau of Aeronautics.

Duralumin is an especially suitable metal for aircraft construction, and, continues Mr. Burgess, its development in this country was largely due to the efforts of the Navy Department in connection with the building of the great airship *Shenandoah*. The use of duralumin has since been greatly extended; and it is now largely found in high grade automobiles, and also in railroad cars. It is likely to come into increas-



Demonstrating the relative corrosive effect of atmospheric exposure on duralumin and steel. The latter is on the right. Duralumin is not very corrosible

ing favor wherever lightness combined with strength and durability are required.

Duralumin was discovered as long ago as 1903 by a German named Wilm, and perfected by him in the course of eight years of laboratory development from 1903 to 1911. Duralumin is an aluminum alloy containing about 3.5 to 4.5 percent copper, 0.2 to 0.75 percent magnesium, 0.4 to 1.0 percent manganese, and not less than 92 percent aluminum. When not heat treated, its physical properties differ but little from ordinary aluminum. Its great merit lies in the fact that it is susceptible to heat treatment by which its strength, ductility, and resistance to corrosion may be greatly increased.

Heat treated duralumin bears much the same relation to aluminum as high-tensile

Section through the corroded surface of a duralumin tube, taken from an airplane after two years' exposure. Magnified 100 diameters. The surface was pitted but no intercrystalline attack had occurred. See text

steel bears to mild steel. It follows that in comparing duralumin with steel, high-tensile steel should be considered. The specific gravities of duralumin and high-tensile steel are approximately 2.8 and 7.9, respectively. Their ultimate tensile strengths are about 60,000 pounds and 220,000 pounds per square inch cross-section, respectively. From these figures it may be seen that weight for weight, the steel is 30 percent stronger, and is therefore the better metal for tension members and for practically all cases where the thickness of the material does not have to be taken into consideration.

In members subject to bending or compression, the strength is largely a function of the thickness of the material, and it is here that the low specific gravity of duralumin is an advantage because it permits greater thickness than steel of the same weight. In technical language, the strength in bending and compression is a function of the moment of inertia of the cross-section of the member, and the moment of inertia is proportional to the square of the mean distance of the material from the center of the cross-section. Thus a thin-walled tube has a much greater moment of inertia than a solid round rod having the same amount of material. But there is a limit beyond which it does not pay to increase the moment of inertia by increasing the diameter and thinning the walls, because an excessive ratio of diameter to wall thickness leads to weakness by "crinkling" of the thin walls. Similarly, in channels and corrugated sections there is a practical limit to increasing the moment of inertia at the expense of the thickness of the walls. The low weight of duralumin permits thicker walls and hence greater over-all dimensions and greater moment of inertia than with an equal weight of steel.

With geometrically similar forms and equal weights of metal, the moment of inertia for duralumin is eight times as great as for steel. In general, the longer a column or strut in proportion to the load to be carried, the more important is it to obtain a large moment of inertia with a small weight of material. It follows that the advantages of duralumin are especially great for long columns carrying relatively light loads. Another important factor in determining the efficiency of a material for a column is its modulus of elasticity, which is measured by the force required to stretch a uniform bar of the material to double its original length, on the assumption that the ratio of force to elongation remains the same as for small forces. The modulus is 30,000,000 pounds per square inch cross-section for steel, and 10,500,000 pounds per square inch cross-section for duralumin. These figures are in about the same ratio as the specific gravities, so that weight for weight, the two metals are approximately equal in this respect.

One of the great merits of duralumin is its high resistance to fatigue. Exhaustive experiments made by the Bureau of Standards and other investigators have shown that it is capable of withstanding upwards of 150,000,000 reversals of a working stress of 20,000 pounds per square inch, alternately tension and compression.

It is in regard to corrosion that doubt has been thrown on the reliability of duralumin. All structural metals are attacked by certain acids and salts. Aluminum and its alloys are susceptible to the action of chlorides, especially calcium chloride or common salt. This salt is a cheap and effective substance for preventing the freezing of water; and it was the principal ingredient in certain anti-freeze compounds widely advertised for automobile radiators a few years ago, until it was found that motors with aluminum parts were seriously damaged by the corrosive action set up. The moral is obviously that calcium chloride must not be used around aluminum and its alloys, and not that these metals are undependable.

Duralumin is subject to a curious kind of deterioration known as "inter-crystalline corrosion," which is a disintegration of the crystalline structure of the metal slowly working inwards from the outside. There is a widespread belief that this action is an auto-disintegration of the metal which cannot be prevented; but the fact that the corrosion always works inwards from the surface, and has never been found in the interior of the metal without a "root" to the surface, is proof that the deterioration is due to penetration from the surface; and the way to prevent it is to provide an adequate protective coating. High-grade varnish containing aluminum powder is the most satisfactory protection known at present.

Even without protective coating, the corrosion of duralumin is so slow that the German practice in the use of duralumin in aircraft is to have no protective coating at all except in places where moisture or other deteriorating matter is likely to collect. The life of unprotected duralumin aircraft structures appears to be about five years, and cases of successful operation for longer periods are on record. There is every reason to believe that with perfect exterior protection, duralumin will last indefinitely without loss of strength or of other properties.

In present-day practice it appears unreasonable to expect perfect protection, and some rate of loss of strength must be allowed for. From our present knowledge, it is very safe to assume that the mean penetration of the corrosion through reasonably well protected and cared for metal will not exceed .001 of an inch per year. Cases of greater penetration have invariably been found to be due to some mistreatment, such as spilling chlorides upon the metal, or in permitting sea salt to accumulate upon it, as in the bottom of seaplane hulls.

At the present day it is amusing to read the criticisms of mild steel, common forty years ago. This useful metal, which is now accepted as a matter of course, was widely condemned as unsuitable for ship building because of its rapid corrosion in salt water. Doubtlessly in a few years the present-day criticisms of the much more slowly-corroding duralumin will be regarded as even more unreasonable and unwarranted than the old doubts about steel.

* * *

Deepest Well in the World

TEMPERATURES which melt electric batteries have been encountered in the work of drilling a well in Orange County, California, already established as the deepest hole in the world. The depth now has passed 8,000 feet—more than 250 feet deeper than the former record made by the shaft of the People's Natural Gas Company on the Lincoln Highway near Pittsburgh. At the depth of 7,000 feet in the California well, temperatures far in excess of 212 degrees were met and the battery of the photographic machines used in making depth surveys, become thoroughly molten. The melting point of this equipment is 212 degrees.

Besides being the deepest well in the world, the new shaft is the only well ever drilled by electric power to a depth of more than 6,000 feet. The well was started on March 13, 1925, and drilling has been continuous. Engineers in charge say that drilling will continue as long as possible. A 5¾-inch bit is used, with Westinghouse transformers and a variable-speed motor.

The shaft of the well has veered from the vertical, drifting 560 feet away from the center at 5,985 feet. Since that depth was reached, the drift has been back toward the center. At 8,000 feet the well is only 28 degrees off.

Other deep wells, aside from the two already mentioned, are: Rosecrans Field, California, 7,591; Fairmont, West Virginia, 7,579; Czuchow, Germany, 7,348; Dominguez, California, 7,320; McDonald, Pennsylvania, 7,248.

* * *

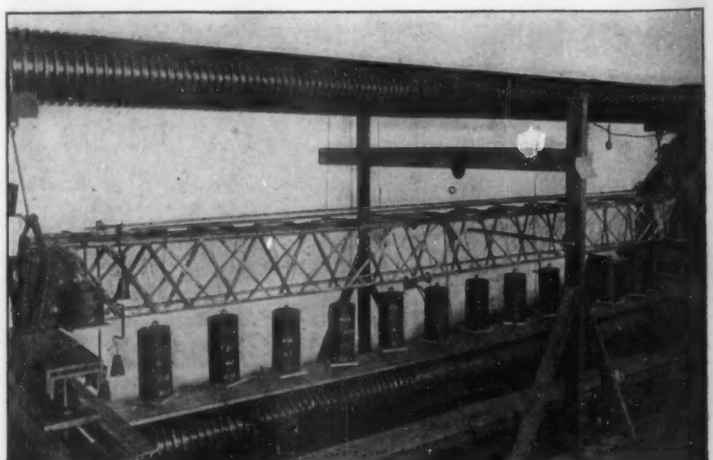
"Mountain-Sickness" and Its Probable Cause

RECENT researches concerning the composition of the atmosphere in high altitudes led to the discovery of facts which shed a strong and extremely interesting light not alone upon the exact nature of "mountain sickness," which attacks human beings and even animals that venture into the mountain regions of high altitude, but also upon the problem of the natural formation of organic matter from purely inorganic constituents.

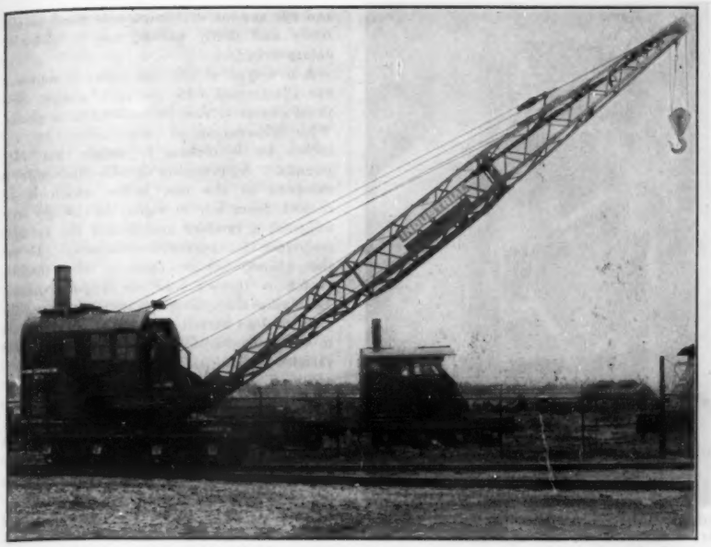
That our atmosphere consists principally of two gases, oxygen and nitrogen, was definitely ascertained toward the end of the eighteenth century. A little more than a century later researches by Lord Rayleigh, Sir William Ramsay and other noted chemists and physicists established the fact that, in addition to oxygen and nitrogen, the atmosphere contains argon, helium, neon, krypton and xenon, all inert gases of the helium group, in practically constant quantities, also carbon dioxide, water vapor and dust in variable quantities and accidental admixtures of sulphur dioxide, ammonia and other gases, as local impurities.

Heretofore it was generally believed that the distressing symptoms produced in human beings and animals in high altitudes were caused by the diminished air pressure and by the inadequate quantity of oxygen contained in the rarefied air of these regions. Recent discoveries, however, have led to the belief that this explanation is only partly correct and that the most important factors in producing mountain sickness are certain highly toxic chemical compounds which are formed from the gases contained in the atmosphere through the actinic agency of the ultra-violet rays in sunlight which are extremely powerful at great heights.

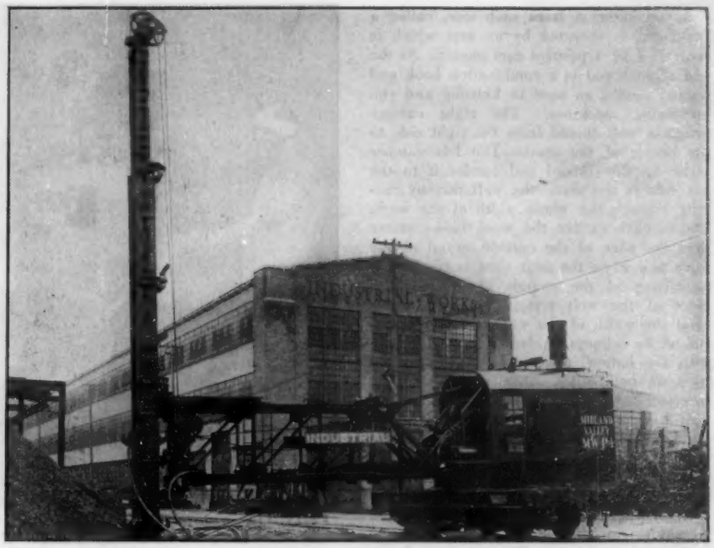
It was ascertained by careful analyses undertaken in a small chemical laboratory on the summit of Mont Rosa, at a height



How tests for the determination of strength are conducted on a duralumin structural member taken from the framework of a dirigible airship



A combination crane and pile driver operating as a crane, using the same boiler, engine and hoisting drums. As shown in the companion illustration on the right, this outfit may easily be changed into a pile driver



The crane-boom has been removed and the pile-driver truss and leaders attached to the boom-foot of the crane. The pile driver has a swing of 30 feet on either side. Being hinged, it can drive piles out of plumb

of approximately 4,600 meters, that the air in those regions contains considerable quantities of nitrogen oxides, ozone, ammonium nitrite and other toxic gases, which, by their chemical effect on the blood may cause in many persons serious pathological symptoms, even death.

The Italian chemist Angeli, who has made a special study of the nitrosyl NOH, which he believed to be the source of the toxic nitrogen compounds in the air at high altitudes, succeeded in proving by laboratory experiments that under the influence of the ultra-violet rays of the spectrum the radical NOH reacted on formaldehyde, forming by synthetic reaction nitrosomethylic alcohol, an extremely unstable compound of deep blue color which spontaneously changes to formhydroxamic acid or methyl alcohol and ammonia. Baley, another chemist, obtained formhydroxamic acid by the interaction of carbon dioxide and an aqueous solution of potassium nitrite in the presence of the ultra-violet rays from a mercury arc. He also found that by circulating air through an aqueous solution of carbon dioxide exposed to ultra-violet rays an organic nitrogen compound is obtained.

Stoklasa and Baley found that, under the influence of ultra-violet rays, carbon dioxide dissolved in water, may change to formaldehyde and, in the presence of an alkali, even to sugar.

These interesting laboratory experiments throw a strong light upon the probable origin in nature of organic compounds by synthesis under the influence of ultra-violet rays which, undoubtedly, were more powerful during some of the remote prehistoric periods than they are now.

* * *

Combination Crane and Pile Driver

A VERY useful addition to the equipment of a large contractor's outfit is the combination crane and pile driver. Wood, steel and concrete piles may be effectively driven with this machine, and it has been found of considerable use by railroads in territories where it is not absolutely necessary to use an enormous pile driver.

Hitherto, the use of cranes to hoist machinery, cars, ties, and other equipment, and the operation of pile drivers, were two separate operations. Now, however, the combined machine performs both kinds of work with only slight alterations.

The basic machine of this particular type is a locomotive crane of 40 tons capacity at a 12-foot radius. With the special built-up leader truss and standard pile-driver leaders attached to the boom-foot of the crane, in place of the standard crane-boom, the user has at once a full-fledged pile driver. This machine has the distinct advantage of being able to drive piles anywhere in a complete circle around the apparatus.

The combination crane and pile driver can be utilized with either a drop hammer or a double-acting steam hammer of 16-inch stroke. The full circle swing of this machine makes it particularly adapted to railroad work for driving piles on trestles or bridges under construction. Rigid parts permit the driving of piles that are not inclined to go straight, while the swinging radius of 30 feet on either side of the center line of the track allows considerable working distance that would be difficult to obtain with other types of pile drivers.

Two views of the combination crane and pile driver are shown; one with pile-driver rigging and the other fitted with the standard crane boom.

* * *

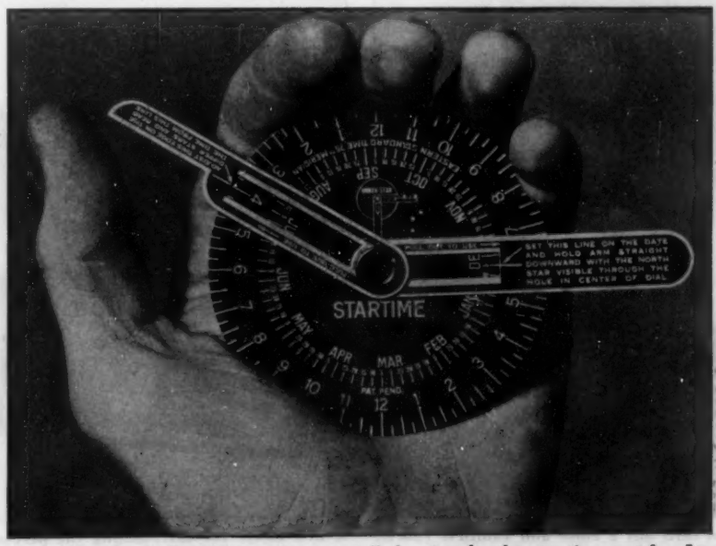
Simple Instrument Tells Time By the Stars

FREDERICK C. MEACHAM of Garden City, Long Island, New York, has invented a device which reduces the relative positions of the North Star and the Big Dipper to the time of day. It is based on the familiar fact that the Big Dipper completes a circuit of the pole star once every 23 hours and 56 minutes, with the two stars which form the outside edge of the Dipper bowl always pointing at the great central star of the northern heavens. It is more than probable that others have recognized the similarity between this course of the Dipper and the course of a clock's hand. But the fact that the circuit is made in four minutes less than 24 hours has prevented the similarity from becoming very useful heretofore.

To combat this problem mechanically, Mr. Meacham conceived the idea of making a disk on which, in concentric circles, both the date and the hours would be indicated. The startime "watch" consists of a black disk with a hole in the center and two movable arms pivoting around the hole. On the circumference of the instrument, the quarter hours of a 24-hour day are marked out. The inner concentric circle is divided up into the months and days of a year.

To "shoot" the stars, the observer first sets the date-arm of the "watch" on the date of the observation. He next holds the instrument up, with the date-arm pointing straight downward and sights the North Star through the hole in the center of the disk. He then moves the time-arm slowly around the circumference until its proper, designated edge is lined up against the two edge stars of the Dipper bowl. Having assured himself that the stars are properly placed on the instrument and that the date-arm is vertically downward, the observer only need look at the small line on the time-arm which he will find pointing directly at the hour of the day.

With this little instrument it is also possible to determine with reasonable accuracy the culmination and elongation of the orbit of the Pole Star, a feature which is of considerable value to surveyors; and it is also possible to make a rough calculation of latitude and longitude.


STARTIME
SET THIS LINE ON THE DATE AND HOLD ARM STRAIGHT DOWNWARD WITH THE NORTH STAR VISIBLE THROUGH THE HOLE IN CENTER OF DIAL

The editor learned within a minute to tell the time by the star-time watch. Its operation is extremely simple

Gasoline Facts

WE have before us a compact little work of 167 pages, by H. G. Mendelson, bearing the title, "Gasoline Facts"—the purpose of which is to acquaint the automobile owner and the man who makes industrial use of gasoline, with some of the fundamental facts of the oil industry, and particularly with those covering the recovery of gasoline from the crude oil. The literature of the oil industry is voluminous, but most of it has been written for the specialist and is couched in language which is more or less unintelligible to the layman. This work is written with the layman in view; it seeks to place before him a broad outline of the oil industry in which the major steps in oil and gas recovery are covered and the story is written with the use of as few technical terms as is consistent with a clear and collected account.

After a preface by David A. Dennison, the book opens with a chapter on "The Industry in General," followed by one entitled, "The Automobile Age." The "Sources of Supply" chapter deals sufficiently with the various oil fields of the country, the output to date, the oil reserves, and the possibility of recovering oil from shales in sufficient abundance, and at a cost which will enable gasoline from shale to take the place—if ever this should be necessary—of gasoline from crude oil, in the industrial and motor world. There are chapters on "Refining," on "Gasoline and Oil Tests," on "Distribution and Economics," on the "Automobile Owner" and a final chapter on "Relations to Government." Of special and timely interest is the discussion of so-called "doped" gasoline and of cracked gasoline, both of which are destined to exert a profound influence on the future of the automobile. We cordially recommend this little volume, which covers very much the same ground as that embraced in our recent chapters on oil under our series on "Conservation of National Resources."

* * *

A Shuttle-less Loom

A LOOM which weaves without a shuttle has recently been developed in Germany.

Back to antiquity can be traced the present method of weaving whereby the simultaneous lifting and lowering of alternate strands of the warp (lengthwise threads) forms a "shed" through which is thrown the shuttle, containing the woof or weft, wound on a bobbin.

At first sight, the Gabler loom seems to be similar to the ordinary machine, as one finds the usual frame, warp-beam, warp and tackle, and other main features of a loom. This difference must, however, be noted: while the weft is inserted from the side, it is not inserted by a shuttle. Moreover, the entire picker-staff mechanism is eliminated.

A rod entering from each side, called a "catcher", is operated by an arm which is controlled by a positive cam motion. At the end of each rod is a combination hook and tongue needle, as used in knitting and embroidering machines. The right catcher brings a weft thread from the right side to the center of the shed. The left catcher picks up this thread and carries it to the left side of the shed—the weft thereby running through the whole width of the work. The catcher carries the woof back farther than the edge of the outside strand of the warp and when the next shed is formed by a shifting of the strands of the warp, a piece of the weft remains protruding beyond the width of the warp. This piece is cut off by scissors, folded back, and beaten with the batten, thereby forming a strong edge on both sides. The process is then reversed for the next woof strand. The weft material hangs on big cross reels above the loom and is unrolled and entered into the rear of the catcher by a simple device. The weft is, as usual, beaten with the reed after being inserted.

At 180 revolutions per minute, this loom is said to run silently and produce a close and faultless fabric. The tension of the weft is very slight so that very loosely twisted thread of lower qualities can be used without fear of breaking. As it is not necessary to open the shed very wide, because of the rod-like shape of the catchers, the warp is under less strain and less breaks occur. A day's supply of weft thread can be hung in place so there is no stopping of the loom to replace bobbins in the shuttle. Variations of color are readily obtained by threading from different reels, and cotton, wool or jute materials can be produced from the same loom.

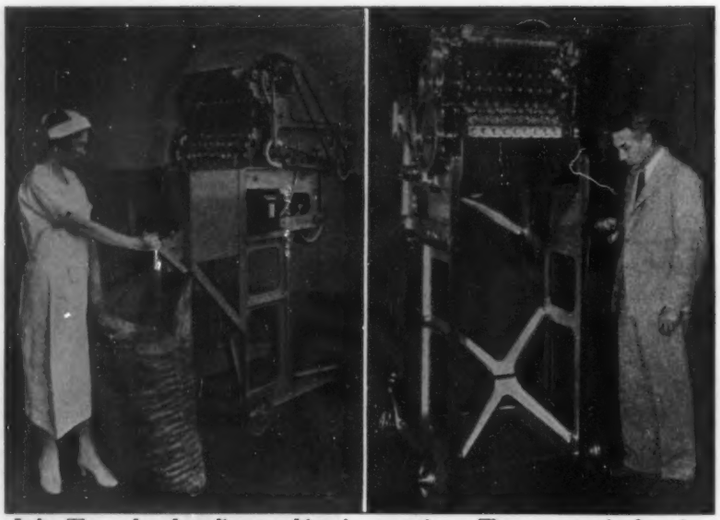
* * *

Printing Walnuts

NATURE puts the quality inside the walnut, but it takes an ingenious electrically driven machine to put the trademark of quality upon them. The device described below is marking them at the rate of over 100 million walnuts in an eight-hour day.

There used to be no way of telling whether walnuts in the open market came from Europe, from the Orient, or from sunny California, and as the imported varieties represent about three-fourths of the annual production or 51,000,000 pounds, the California Walnut Growers' Association found it desirable to work out a method by which the consumer would be able to identify every walnut in the first grade and fancy packs, which are conceded to be the best on the market.

This machine prints the trademark upon the seamy surface of every walnut so neatly that practically every brand is legible, and it is done so rapidly and inexpensively that the cost is only one-twentieth of a cent a pound. No part of the cost is added to the wholesale price of the product.



Left: **The walnut-branding machine in operation. The operator is dumping branded nuts into a bag.** ***Right:*** **Rear view of the machine**

One of these machines can turn out branded walnuts at the rate of 2,016 per minute, handling a carload of 30,000 pounds in a single day. The organization has 125 of the machines at work in its 45 local district packing houses.

The machine is the result of broadcasting an offer of 10,000 dollars in cash for a machine which would brand walnuts, from which offer several thousand replies were received from all corners of the globe. Also upwards of 100 working models were submitted. Rees and Wilkinson, Los Angeles machinists, won the prize and in addition are to receive a royalty for ten years.

The work of this machine is accomplished chiefly by two cylinders, the upper and smaller one bearing the branding devices, the lower and larger one carrying the walnuts up to the point where they come in contact with the stamps. Above the stamping cylinder is an ink fountain, similar to that of a job press, which inks the brands before they come in contact with the walnuts.

An inclined endless draper traveling upward and in under the automatic feed hopper, moves forward over the lower cylinder. The draper is carried by a link belt at each side. Suspended between the links on either side are sets of aluminum bars. Each of these has nine depressions in a row. The depressions are perhaps two inches across, and are just deep enough to carry the average walnut. These rows of bars are separated slightly, to give them the necessary flexibility as the draper moves along. When the draper travels under the feed hopper, the walnuts, sliding down into the narrow slit at the bottom of the hopper, fill each row of cups, after which the rows move forward to the branding cylinder.

Paralleling each other on this cylinder are eight corrugations, each being about three-quarters of an inch deep. The branding dies are ordinary rubber, cemented upon sponge rubber bases which are in turn fastened to rubber bands. They are fastened into the cylinder by wire staples. The cylinder carries 72 stamps.

Drawn tight across the corrugations in the cylinder, the rubber stamping devices are flexible enough to permit them to be pushed back somewhat as the dies descend upon the walnuts. In this way the pressure automatically adjusts itself to the size or shape of the walnut in each cup, so that the imprint of the trademark is uniformly even and the pressure not too great for paper-shell walnuts.

The draper passes over its cylinder 28 times every minute, and as each bar passes from beneath the row of stamps it pours out the branded walnuts upon a carrier belt which conveys them to the sack. The machine is operated by an electric motor of one-half horsepower.

* * *

A New CO_2 Meter

THE analysis of flue gases has always been quite an operation, for such apparatus as the present Orsat requires delicate handling and the various determinations must be correctly and deftly carried out in order to obtain accuracy.

A new type of CO_2 gas meter is shown in our illustration. Its compact, simple, foolproof character can be realized at a glance. With dimensions of 6½ inches by 7½ inches by 9 inches, it weighs but 14½ pounds. A precision profile indicator is mounted at the top, below which is arranged, from left to right, the bridge zero-adjuster, a tumbler switch and the variable resistance for current adjustment. To set the proper bridge current, the tumbler switch is thrown into the upper position. This cuts the precision indicator into the circuit as an ammeter and the current is set to the top-mark deflection by means of the variable resistor. Three standard dry cells are used as the current source and are connected to the two binding posts in the lower left-hand corner. When making temperature measurements, the tumbler switch is thrown into the downward position. Any standard thermocouple can be connected to the lower right-hand terminal and the reading made on the millivolt scale. By means of a millivolt-temperature curve, the temperature is determined.

For the analysis of flue gas, the tumbler switch is thrown into the center position. The gas is sampled by means of a hand aspirator which may be attached to either side of the box. There is a nipple in a protective recessed disc on the left side of the instrument similar to that on the right side as shown in the photograph. The gas passes in at one side and out the other.

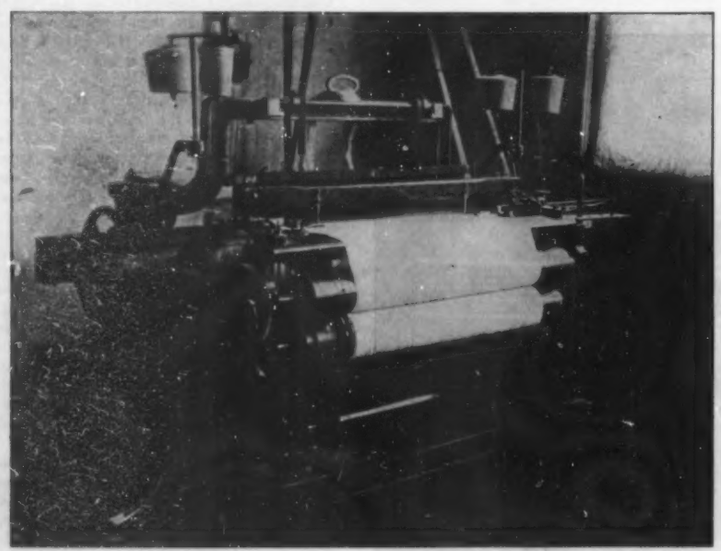
The bulb aspirator is attached to one nipple by means of a short length of rubber tubing. A rubber hose connection is made between the other nipple and one end of the filter. (The glass tube contains calcium chloride and absorbent cotton.) The other end of the filter is then attached to a sampling tube by a rubber hose and the sampling tube is inserted in the stack. Due to the suction of the aspirator, the passage of gas from the stack is then as follows: through sampling tube, filter, CO_2 determiner and aspirator, in the order named.

The sampling tube consists merely of a plain iron tube or pipe one-quarter inch inside diameter which is inserted into the stack in a convenient place. It may be left in the stack permanently or the same tube may be used for several stacks.

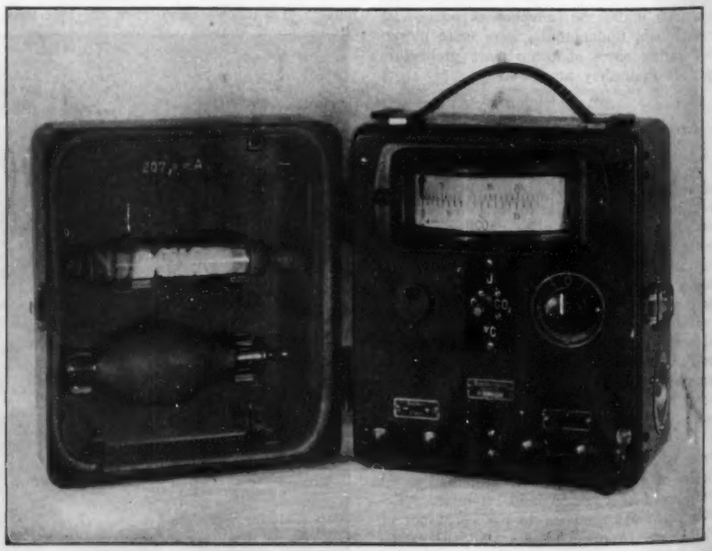
* * *

Throwing Away Cement

WATERPROOFING concrete with water is the possibility pointed out by Cloyd M. Chapman, chairman of committee on concrete of American Society for Testing Materials. "By regulating the amount of water a more water-tight concrete may be made than if too much or too little water is used," Mr.



This loom has no shuttle but it is said to turn out a close and faultless fabric. The machine runs quietly at 180 revolutions per minute



A new meter for determining the percentage of carbon dioxide in flue gases—one test of good fuel combustion. All large power stations use CO_2 meters

Chapman explained. "The same is true of durability and wearing qualities. Any owner, engineer, architect, or contractor who neglects this factor is not getting the most for his money in concrete."

It is the common notion that the strength of concrete is entirely dependent upon the amount of cement in it, that to make stronger concrete more cement must be added. This is not true. The cheapest ingredient in concrete is the one that really controls its strength. A sloppy concrete mixture will make about half as strong a concrete after it sets and hardens as will exactly the same concrete mixture with one-fourth less water. An extra gallon of water added to a one-bag batch of concrete is about equivalent to taking out of the mixture 15 pounds of cement and throwing it away, so far as the strength of the concrete is concerned.

A one-two-four mix is commonly considered "good concrete." So it may be, if the materials are all of good quality and about six gallons of water are used for each bag of cement. The resulting concrete, if properly handled, will have a crushing strength of about 3,000 pounds per square inch at the age of a month, and probably 4,000 pounds or more in a year. But for every pint of water used in excess of the six gallons the strength at the end of a month will be reduced about 100 pounds. If eight gallons of water are used, instead of the six, the strength would be only about 1,500 pounds per square inch. To repair the damage done by those two extra gallons of water it would be necessary to add about one-third more cement. With cement selling at more than two dollars a barrel, it becomes rather expensive to neglect to take those facts into account.—*Science Service.*

* * *

Temperature 30 Miles Up Puzzles Weather Men

An adventurous human being who plans to travel 30 miles away from the earth will do well to include an asbestos overcoat in his equipment, for some weather experts believe that the upper air may sizzle at a temperature above the normal boiling of water, or two hundred and twelve degrees, Fahrenheit.

New evidence which has set meteorologists to speculating on this weather problem has been obtained by a series of experimental explosions set off by scientists in France.

Thirty tons of melanite were used in setting off four explosions at La Courtine, a point about half-way between Paris and the Pyrenees. Observers at Bordeaux and other places radiating from La Courtine were notified when the explosions were to take place, and recorded the time at which the sound reached them. The experiments have attracted considerable interest, because few tests of the audibility of sound waves have been made in which a number of observers were waiting to make exact notes of their reception of the sound waves.

Several hundred observations were made during each experiment and by studying these notes in connection with wind and temperature conditions at the time of the explosions, scientists are making some deductions as to the state of the upper air.

Prof. Charles Maurain, director of the Institut de Physique du Globe, at Paris, who has just reported the result of the tests, has assumed that the upper atmosphere is uniform in temperature up to over 30 miles. J. F. Whipple, British meteorologist, studying the experiments finds reason, however, to believe that the temperature begins to rise at about 20 miles and that at 30 miles the heat may reach 220 degrees, Fahrenheit.

This theory, that the upper air may be hot, instead of about 75 degrees below zero, is also held by Prof. F. A. Lindemann, of Oxford University. The hot upper air theory has been recently questioned, however, by Dr. C. M. Sparrow, professor of physics at the University of Virginia, who holds that the atmosphere does not become any warmer with the increase of height.—*Science Service.*

Bearings and Grinding
—world efficiency and high speed

The world's precision machinery and fast-moving vehicles depend for their efficiency and speed on ball and roller bearings.

Anti-friction bearings by the millions are being produced in great plants employing thousands.

One of the major production operations—one that has made ball and roller bearing accuracy possible—is "grinding". Batteries of Grinding Machines are to be found in every ball and roller bearing plant.

Many of these plants are equipped with Norton Grinding Machines. Many of them use Norton Grinding Wheels and Alundum Polishing Abrasives.

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In the World of Chemistry

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Conducted by D. H. Killeffer

What of Synthetic Rubber?

CONTROL of sources of rubber by the British Government has led to much discussion of the possibilities of producing synthetic rubber from other sources than the sap of *hevea brasiliensis*, the present principal producer of the rubber of commerce. Discussion has centered about two points, depending upon the opposing views represented. The organic chemists are inclined to view favorably the possibility of the ultimate production of a rubber material from petroleum products, and the rubber growers, as well as most others now interested in the rubber industry, believe that improvement in methods of cultivation and production already in sight will postpone indefinitely the necessity for looking to other sources of rubber than those now recognized. It is quite probable that the arguments deduced by the synthesists from the analogy of rubber with indigo, successfully synthesized a quarter of a century ago and now no longer an important crop, have in them a possible element of over-optimism. Certainly this is true of the present rubber situation, but it is also true that much time, thought, energy and money are already being spent with a view to the practical synthesis of rubber.

Speaking before the Institute of Politics at Williamstown, Massachusetts, during the past summer, Prof. Roger Adams of the University of Illinois, made the following statement of the theoretical possibilities: "The total annual yield of rubber per tree is only about three pounds. It requires the output from two full-grown trees for a whole year to supply the rubber for one 29 × 4 (Ford size) cord tire. These figures give some idea of the magnitude of the industry and of the importance that the solution of this problem will have to the American manufactured-rubber industry.

"Rubber has been made synthetically and the types of raw material necessary are well known. But the serious problem is to find a source of this raw material which is cheap enough to make possible competition of synthetic rubber with the natural. Petroleum offers a possibility. When the high-boiling petroleum is cracked, in order to obtain low-boiling fractions which can be used as gasoline in internal combustion engines, there are contained in these low fractions butadiene and its derivatives, the type of compounds which have been shown to be convertible into synthetic rubber. It remains for the scientist to find how the yield of these butadienes may be increased and how they may be economically removed from the other closely related products which accompany them. When this difficult problem is solved, synthetic rubber will not be far off.

"Suppose that a 5-percent yield of butadienes might be obtained by a proper cracking and extraction process. On this basis, and assuming that the butadienes might be converted quantitatively into synthetic rubber (a goal which, to be sure, has not yet been reached), it would require the cracking of 52 million barrels of petroleum to provide the necessary butadienes for forming 4 billion pounds of rubber. The total yield of crude oil in the United States in the year 1925 was 758 million barrels and, as a consequence, the volume of 52 million barrels does not appear so large. Moreover, it must be considered that after the 5 percent of butadienes has been separated, the residual petroleum and decomposition products will be available for other purposes and will be decreased in value only by the actual loss in weight of the butadienes removed."

During the World War, the Germans were completely isolated from sources of natural rubber and some success was achieved in producing rubber-like materials from acetone as a raw material. At a recent meeting of the American Chemical Society at Philadelphia, C. C. Burgdorf of the Grasselli Dyestuff Corporation and Richard Weil of the Continental Caoutchouc and Gutta-Percha Company, of Hanover, Germany, discussed various phases of the German experiences with synthetic rubber. "As a general rule it can be said that the vulcanized product obtained from artificial rubber was good enough for the average technical use of soft rubber, although not so good as the product obtained from natural rubber," said Mr. Burgdorf. "For hard rubber, our polymerization gave excellent results. By vulcanization, goods of high elasticity and of better dielectric behavior were obtained, which for certain purposes were no doubt superior to those obtained from the natural product. Artificial rubber is a chemically pure hydro-carbon, free from ash and other impurities, and for electrical purposes is more uniform and reliable. For dental work, it was preferred to natural rubber."

As to the commercial feasibility of such artificial rubber, Mr. Burgdorf continued: "The question as to whether artificial rubber, as made in Germany during the war, could be competitive with natural rubber in quality and in price has been partly answered by the fact that interest ceased when rubber prices became normal. . . . Although no exact figures for world consumption of rubber per year are available, 300,000 tons is probably not far from right. Not many raw materials could be bought in such large quantities without raising the price. The capital needed for a rubber plant producing 3,000 tons per annum, or less than 1 percent of the world's consumption, would be ten to fifteen million dollars, to which the plant necessary for producing the raw material (acetone) would have to be added." As the process was practiced in Germany, several months elapsed between the entry of the raw material and the shipment of the finished product from a plant and hence large amounts of working capital would be required.

Dr. Weil pointed out that while isoprene gave the greatest promise as a raw material for rubber manufacture, its preparation was difficult and was given up by the Germans during the war in favor of the use of dimethyl butadiene, which could be more easily prepared from the lime and coal available at the time. After a discussion of the qualities of the rubber produced, Dr. Weil assumed a rather optimistic attitude on the question of possible commercial production of synthetic rubber and said:

"During the war, the price of synthetic rubber fluctuated between 30 and 40 marks (gold) per kilogram. Now it is cut to about 15 marks. But these figures mean nothing. The value which lies in the development of this problem cannot be expressed in figures alone. The true results do not appear until later, as is so often the case with chemical discoveries and inventions. What fluctuations the price of raw rubber has undergone! The price of raw rubber once nearly reached the war price of synthetic rubber. If the use of rubber continues to increase at the same rate as in the past, it may be assumed, according to expert opinion, that in a few years there will not be sufficient area under cultivation to satisfy the increasing demand. New plantings would not become productive until 1934. Old plantations will become exhausted, so the price for raw rubber for the next ten years may be relatively high. . . . The problem of producing a material equivalent to raw rubber should not be taken up with a view merely to the advantage of the moment. No one knows how events may shape themselves."

Apparently many financiers have been discouraged by these German efforts and there is now very little active work being done with the view to the commercial synthesis of rubber. One American laboratory, at least, is actively engaged upon it and a number of others are working on problems which may be related to its ultimate solution, but most of these are pursuing other lines of investigation with other objects in view and what is being done on the synthesis of rubber is more or less incidental for the moment to other more pressing problems. The Soviet Government of Russia has recently announced two prizes totaling 75,000 dollars for processes for the synthesis of rubber and it hopes in this way to encourage research that may ultimately lead to its independence of foreign sources.

In the matter of synthetic rubber, as with numerous other problems of the kind, it must be understood that the users of rubber are not necessarily concerned about whether the manufactured product which may ultimately displace natural rubber is identical with it or not. The success of the rayon industry in supplying a material having many, but not all, of the properties of silk would lead one to believe that a rubber-like material possessing plasticity, elasticity, and the other desirable characteristics of rubber might be found which would not be chemically similar to rubber at all.

On the side of the rubber growers much has been said which would indicate that the day of synthetic rubber or rubber substitutes for general use may be farther off than many now believe. Mr. Samuel Wierman, a recognized expert on the growing of rubber, told the New York Section of the American Chemical Society at a recent meeting that the rubber situation becomes acute only because "the production of the present supply of crude rubber is so closely held by one or two nations as to be capable of being manipulated." Continuing, Mr. Wierman said, "Let it be emphasized that the production of crude rubber is almost entirely an economic problem and presents no particular difficulties from an agricultural viewpoint. Throughout the tropical regions in the world are millions of acres of land with suitable climatic and soil conditions for growing rubber-producing plants. The major problem is to produce this rubber at a low cost or at least at a competitive cost with the existing sources of supply. This is mostly a matter of favorable labor and transportation conditions, two factors, fortunately, capable of being developed and organized by human effort.

"I am not sure but that all the talk during the past few years of what the Americans were going to do concerning rubber has been harmful rather than helpful, inasmuch as this talk has not to date been accompanied by much action. The normal development which would have proceeded in the now existing rubber-producing centers has been retarded by all this talk of what the Americans were going to do in the mistaken impression that any large American effort would adversely effect their own. However, if the statistics are indicating correctly, in ten years hence the world will need all the rubber grown by everyone. Perhaps the ideal solution of the problems would be for each large rubber manufacturer to develop its own rubber plantations, as is now being done by one of the foremost American companies. A plan I would like to see tried is one in which the rubber industry as a whole would combine to develop rubber production in many different countries. Even an annual assessment of one-fifth of one cent per pound of rubber used in America would produce an amount sufficient for developing about 40,000 acres, or say four units of 10,000 acres each in four different places, nuclei for further developments as circumstances warranted.

"I doubt if there is a possibility of any development of synthetic rubber replacing the natural product. Even with the present average production of three to four hundred pounds per acre per annum, on favorable plantations the cost of production can be kept well below 20 cents per pound, even allowing for probable increased labor cost in the future. And as progress is made in the propagation of high-yielding strains (of rubber trees) this production might well reach a thousand pounds per acre per annum with a correspondingly lower cost of production. So far as the production of synthetic rubber has progressed, it is being prepared from a not very cheap raw material and it would seem that any progress in the direction of a substitute for natural rubber is as likely to be an entirely new material answering the requirements demanded of rubber rather than along the lines of a synthetically prepared rubber."

W. C. Geer, a recognized authority on rubber, goes even farther and says: "The world has little to expect, and the planters nothing to fear, from synthetic rubber; and in the inevitable cost competition which would arise, were synthetic rubber to be produced, the planter would be able to deliver crude rubber on board ship at a profit to himself, and at a price to which synthetic rubber could not be brought."

Experiments on Corrosion of Iron

THOSE interested in experimentation may find both interest and instruction in trying the "ferroxyl" reagent of Dr. Allerton S. Cushman, devised some years ago for the study of the phenomena of corrosion. The reagent consists of a neutral solution of gelatin to which has been added a small amount of potassium ferricyanide (red prussiate of potash) and a drop or two of phenolphthalein test solution. The reagent is heated and poured into Petri dishes (the ordinary culture dishes of the bacteriologist). If small bits of iron be now dropped into the reagent, they will soon develop anodic and cathodic areas, setting up electrolytic cells. The iron will dissolve from the anodic areas and be precipitated from solution as Turnbull's-blue.

At the cathodic areas, there is preponderance of hydroxyl ions and the phenolphthalein is turned a rich red by them. No matter how pure the piece of iron used may be, these areas will develop and it can be shown that an area of strain in a pure piece of iron wire will become anodic to the rest of the piece. For example, if a bright iron nail be dropped into the reagent, anodic areas will be developed at scattered points on it. If a similar nail be flattened by a hammer at some point along its length, thus setting up a very much strained area, and this nail be put into the reagent, only the flattened part will show itself anodic.

The protective action of zinc against the corrosion of iron may be shown by dropping a very small particle of zinc into contact with a nail, when the nail will become cathodic and an area of red from the phenolphthalein will surround it. Since the zinc ferricyanide is soluble in the reagent, it will not form a visible evidence of the fact that it becomes the anode. If a piece of

(*Continued on page 58*)

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MORE serious illnesses than you can count on the fingers of both hands start with the warning signal, an irritated throat.

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Figure 1: **Two wire nails in ferroxyl reagent. Turnbull's-blue precipitates as a result of the solution of iron from anodic areas. The cathodic areas are outlined in pink (indistinct in the photograph) as a result of the accumulation of hydroxyl ions there. One of the nails (2) was strained near the middle and hence develops different areas from those of its unstrained companion**

copper be put in contact with a nail in the reagent, the iron begins to dissolve rapidly and an immediate formation of the blue precipitate will surround it, the copper being in the meantime surrounded by the red color produced from the phenolphthalein. Many other interesting phenomena may be observed by modifications of this procedure.

Those who wish to experiment with this interesting reagent may be interested in the following directions for its preparation:

A solution of two grams of potassium ferricyanide (red prussiate of potash) in 25 cubic centimeters of water is added to a hot solution of a heaping teaspoonful of clarified (uncolored and unflavored) gelatin in 150 cubic centimeters of water. To this mixture, add five drops of phenolphthalein test solution, or failing this, three to five drops of a solution of phenolphthalein prepared by mascerating half a Phenolax wafer in five cubic centimeters of sodium hydroxide solution (½ gram sodium hydroxide in 25 cubic centimeters of water). The gelatin solution at this point is acid, as indicated by the absence of the pink color of alkaline phenolphthalein. It is neutralized by adding sodium hydroxide solution (prepared as above) drop by drop until a pink color not destroyed by stirring is obtained.

Vinegar, or some other very dilute acid, is now added drop by drop until the pink color is just destroyed. It is desirable to add just as small an amount of acid as possible to discharge the color as too much acidity in the solution is to be avoided. Water is now added to the neutral reagent to bring its volume up to 250 cubic centimeters and it is ready for use. In use, it is warmed, poured over specimens arranged in convenient dishes, whose corrosion characteristics are being observed, and cooled rapidly. It must be noted that this reagent is particularly designed to show corrosion of iron and the effect of other metals upon it.

Figure 2: **A bright steel needle (1), a short piece of tinned iron wire (with part of the tin filed away, 2), and a piece of galvanized wire (part of the zinc has been filed off, 3), make a colorful exhibit in ferroxyl reagent. The reagent is bright lemon yellow, anodic areas are brilliant blue and cathodic areas are pink**

Wholesale Killing of Moths

AT a cost of less than 1,000 dollars, woolen cloth and felt in storage in the quartermaster's depot of the United States Army at Jeffersonville, Indiana, to the value of some 620,000 dollars was recently saved from destruction by moths by the application of methods of chemical warfare learned by the army in the World War. Lieut. Harry A. Kuhn, of the Chemical Warfare Service, who carried out this disinfection by means of cyanogen chloride, describes the methods used, in *Chemical Warfare*, official organ of the Service, as follows:

"A brick building, formerly used for shrinking woolen cloth, was selected for the fumigation. This building is 122 feet long by 62 feet wide and 15 feet high. It contains seven chambers of sheet iron, each 7 feet 6 inches wide by 84 feet long by 14 feet high. In one end there is a small iron door, while a double iron door forms the other end. Each chamber has six 30 inch open ventilators in the roof and eight openings in the floor which lead to an exhaust fan. The chambers open into a room 23 feet by 60 feet which contains three hoods connected to an exhaust fan.

"The fumigant used was generated in stoneware crocks by dropping charges, consisting of six ounces of sodium cyanide and three ounces of sodium chlorate, into a mixture one part of water and one part of commercial hydrochloric acid. In the actual fumigation three such charges of cyanide-

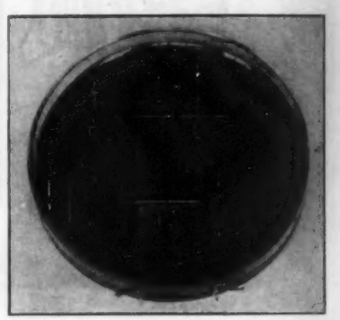

Figure 3: **A beautiful illustration of the difference between the corrosion characteristics of tin- and zinc-coated iron. Wherever breaks occur in a tin coating, iron dissolves readily as shown by the piece of tinned wire (1). A zinc coating will dissolve completely away before the iron to which it is attached is touched at all, as shown by the piece of galvanized wire from which the zinc has been filed in several places (2)**

chlorate mixture were used per thousand cubic feet of free air space—an unusually high concentration to assure killing moth larvae and their eggs. The gas generated is highly poisonous and hence the laborers employed on the actual fumigation were all ex-soldiers equipped with special gas masks.

"Each of the men had been assigned a chamber. In this he first placed the crocks containing the acid. Beside each crock he placed two or three charges of cyanide-chlorate mixture. The men were masked and the masks inspected by the Chemical Warfare Officer. The man assigned to the chamber took station at the far end, the Chemical Warfare Officer midway down the chamber and the other three men at the double doors. On signal, the charges were dropped in the crocks by the man assigned to each chamber, who worked from the rear to the front. The three men at the doors closed and sealed them as soon as the two men inside the chamber came out. The procedure was carried out at each chamber and worked very well as it kept all the men in the building in view of one or more men at all times.

"The chambers were filled with the gas at 1 P.M., on September 3rd, and were emptied of the gas 24 hours later. The conditions for releasing the gas were very favorable. It was Saturday afternoon, a half holiday, with few people in the Depot; the temperature was 90 degrees, Fahrenheit, and

there was a 15-mile wind blowing directly into the doors of the chambers.

"From actual observation by the Chemical Warfare Officer no trace of the gas could be detected 50 yards to the leeward of the chambers during the entire time they were being evacuated. They were emptied one by one by removing the caps on the roof ventilators and then opening the chamber doors. This gave excellent ventilation. The crocks containing the spent acid were then removed and emptied.

"An inspection of the melton cloth after fumigation showed no effect on the color or fabric. An inspection of the rolls as they were removed from the chamber showed no living moths or larvae. The moth flies in the blankets were all killed and so were the larvae except in the center of the blanket on the floor, in which there were a few larvae still moving. These larvae died later. Eggs were removed from each layer and have been under observation for a month and are apparently all dead. They are being incubated to determine this definitely."

The Heavens in January

By Prof. Henry Norris Russell, Ph.D.

At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: Jan. 29.

NIGHT SKY: JANUARY AND FEBRUARY

The Heavens

IN our survey of the heavens this month we find a great array of the winter constellations in the south.

Orion is on the meridian, with Taurus above on the right, and Canis Major below, on the left. Auriga is right overhead, and Gemini very high in the southeast with Canis Minor below. The eastern sky is less brilliant, but Leo is conspicuous, due east, and Ursa Major in the northeast, while Hydra, rising straight up from the southeast horizon, is fairly prominent.

Draco and Ursa Minor are in the north, low down, and Cassiopeia and Cepheus in the northwest. Pegasus is setting, farther to the left, and Andromeda and Perseus are visible above and to the east, and Aries farther to the left while Cetus and Eridanus fill the large blank region in the southwest.

The Planets

Mercury is a morning star when the year begins and remains so until January 28th, but he is too near the sun to be seen well except at the very beginning of the month. Venus is now an evening star, setting about 6 P.M. on the 15th. She is so bright that she can easily be seen in the twilight. Mars is rapidly receding from the earth—his distance increasing from 75 to 95 million miles during the month. He is in the constellation Aries, and remains in sight until about 2 A.M. Although much fainter than at opposition, he still rivals any star but Sirius.

Jupiter is an evening star in Aquarius, and sets a little before 8 P.M. in the middle of the month. Saturn is a morning star in Scorpio, and rises about 4 A.M. on the 15th. Uranus is in Pisces and comes to the meridian at 4 A.M. about the same date, while Neptune is in Leo and is observable from 10 P.M. until dawn.

The moon is new at 3 P.M. on the 3rd, in her first quarter at 10 A.M. on the 10th, full at 5 P.M. on the 17th, and in her last quarter at 9 P.M. on the 25th. She is nearest the earth on the 7th, and farthest away on the 23rd.

During the month she passes near Mercury on the 2nd, Venus on the 4th, Jupiter on the 6th, and Uranus on the 8th, Mars on the 11th, Neptune on the 20th, and Saturn on the 28th. On the last date Saturn is occulted by the moon. As seen from Washington, the planet disappears behind the bright crescent of the moon at 7:04 A.M. (while the two bodies may still be seen in the dawn) and comes out on the other side at 8:30, in full daylight, so that a telescope will be required to observe the reappearance.

Besides this, the moon eclipses the sun on January 3rd. Her shadow is not quite long enough to touch the earth so that the eclipse is annular. The track of central eclipse extends from the northern extremity of New Zealand across the South Pacific, and ends by crossing Chile and Argentina, passing close to Buenos Aires. The moon's apparent diameter is only a very little less than the sun's so that the annular phase lasts but a few seconds, and the darkness should be very conspicuous. But except in Australia and South America, only voyagers at sea or a few islanders can see even the partial phases.

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Who Can Fly?

AT the last International Air Congress, held in Brussels, considerable attention was given to the medical aspects of aviation. Undoubtedly medical research in regard to aviation must keep pace with mechanical progress if complete safety is to be attained. Among the important questions discussed at the Medical Sessions of the Congress was that of the aptitudes required for flying. Wing Commander T. S. Ripon of the British Air Ministry summarized careful investigations. As a result of a large number of examinations on aviators, they were classified as follows:

The average aviator.
The super aviator.
The crasher.

In the Commander's opinion, all normal adults under 45 who had not lived a purely sedentary life and strained their eyes by close work, and who were not unusually nervous should succeed in becoming average aviators.

Super aviators were individuals possessed of the flying temperament. They had good "hands," their reflexes were rapid and accurate, they had a sort of instinctive foresight and alert power of attention.

The "crasher class" could be detected by medical examination. They comprised the following types: the erratic lander suffering from defective vision; the individual who fainted at altitudes: those who got dizzy and lost control in a spin; those who suffered from dimness of vision at night; and finally those who were unable to stand fatigue.

If the Department of Commerce follows army and navy practice in its certification of pilots, and evolves a thorough yet not too rigid a system of physical examination of all pilots, there is no doubt that the safety of commercial flying will be greatly enhanced thereby.

Overlap of Propellers

ACCORDING to a well informed writer in *Aviation*, more than a thousand metal propellers have been used in the United States in recent years—some with hundreds of hours of service without signs of failure. A recent accident on a Ford three-engined monoplane, where a metal propeller broke with disastrous, though not fatal consequences, has caused much discussion of metal-propeller durability. In this particular accident, the cause was not so much the usual fatigue, however, as overlap of the three propeller disk areas.

The speed of the air behind the propeller, the "slipstream," may be as much as 35 percent greater than the speed of the 'plane itself. If, therefore, three propellers are disposed as shown in the illustration, with the outer propellers working partially in the slipstream of the center propeller, the blades of the outer propeller work in an air stream of periodically varying speed. This induces varying forces on the blades and consequent vibration.

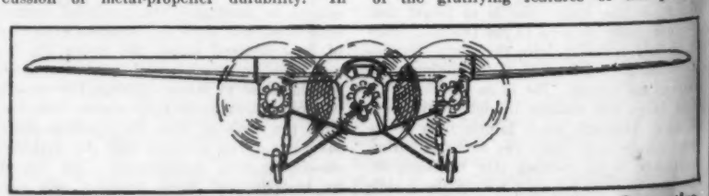
It would seem a good plan to avoid overlap in three-engined plane design by placing the screws further apart, even at the expense of a greater unbalanced turning moment when one of the outer engines goes out of commission in the air.

American Airline Operations

THE contract air-mail routes now number fifteen. They act as feeders to the great transcontinental airway at present, but may be extended to cover the whole territory of the United States. They are still in a probationary stage, both from the point of view of financial success and of technical regularity of operation, and their statistics are accordingly being watched with great interest.

The Robertson Aircraft Corporation is functioning between St. Louis and Chicago, with a single-engined plane equipped with the Wright Whirlwind of 200 horsepower. The Robertson Corporation tells us that their costs are at the rate of 70 cents a flying mile, or $2.80 per ton-mile of mail carried. Out of a schedule of 188 trips, 187 were completed. In the uncompleted trip, due to a severe storm, the pilot landed 30 miles from his goal and the mail was entrained at that point. It is interesting to learn that, in the case of this company at least, reliance is not solely placed on its share of excess postage for the making of revenues. The Robertson Corporation does a general business in aerial taxi operation, cotton dusting, aerial photography, et cetera, which seems a very wise practice in the experimental stages of air-line operation.

Two or three years ago, the only American passenger service, that of the Aeromarine Company between Havana and Key West, was abandoned for want of patronage. One of the gratifying features of the present



The shaded portions represent high-speed air-streams that induce destructive vibration effects in the two rear propellers

year was the resumption of regular passenger carrying, this time by the Philadelphia Rapid Transit Corporation, with its tremendous prestige in the matter of transportation. The service started on July 6, between Washington and Philadelphia, using Fokker three-engined monoplanes, with Wright Whirlwind engines. The service was subsequently extended to Norfolk, Virginia. The schedule has been kept at an efficiency of 97 percent. A total of 44,240 miles have been flown and 2,113 passengers carried, up to September 27. Due to unfavorable weather, four trips were abandoned with safe return to the airdrome, and seven trips cancelled. There were three forced landings due to unfavorable weather—*but not a single forced landing due to power-plant failure.*

Other operators are fully cognizant of the advantage the multi-engined plane is likely to give from the point of view of regularity. Thus, the Colonial Air Lines operating between Boston and New York are supplementing their fleet of small single-engined planes with the larger three-motored ships. This line is employing a Fokker Universal, with the inevitable Wright Whirlwind engine. These planes carry 800 pounds of pay-load, or four pounds of pay-load per horsepower.

It is largely in the extension of the pay-load per horsepower that commercial success lies. The Colonial has flown this summer 43,785 miles in 486½ hours, but with an efficiency of only 87 percent, due to the unusual prevalence of fog and ground haze, accompanied by high winds and rain. There we have the recurrence of weather trouble.

Efficient radio communication, weather reporting and adequate lighting of the route are expected to improve efficiency. Ahead of aid to be received from the Department of Commerce, this company has spent 30,000 dollars on General Electric revolving beacons, and on flood lighting equipment of 500,000,000 candlepower at the terminals! Apparently these operators are not worried so much by the problem of efficient operation as by that of getting traffic. The Colonial has a chief of traffic with four assistants, and carries on an active campaign of survey and solicitation. American business is somewhat slow to realize the tremendous advantages this new form of transportation can place at its disposal.

The Pacific Air Transport Company operates the longest of the contract mail routes, that of 1,099 miles between Los Angeles, San Francisco, and Seattle. This Company had also set up a lighting system of its own before receiving aid from the Department of Commerce. Our photograph shows one of the 24-inch beacons of 7,500,000 candlepower mounted on top of a 50-foot tower. On clear nights they are visible for a range of 75 miles. This company is operating with a Ryan M-I monoplane using a 200-horsepower Wright Whirlwind engine; typical equipment of the feeder-line planes.

Erecting a 7,500,000-candlepower revolving beacon on the Pacific Air Transport line. It is visible 75 miles away on a clear night

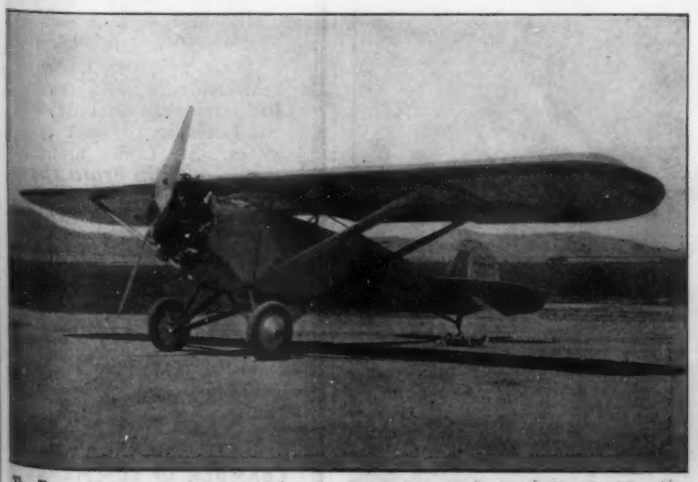
The monoplane shown in our photograph has a span of 36 feet, carries at least 500 pounds of mail load, has a gasoline capacity of 450 miles at a cruising speed of 100 miles per hour and a maximum speed of 120 miles per hour. The Curtiss-Reed metal propeller is in evidence and the air-cooled engine is exposed completely, which although aerodynamically inefficient, is probably justified by considerations of cooling and reliability. There is a no-axle chassis and the pilot is seated well behind the mail compartment where his vision is excellent and his protection in a crash is at a maximum.

American operators do not seem to await government regulations before doing everything possible for safety. Thus, the Pacific Air Line equips its ships with the latest and best instruments, landing and running lights, parachute flares, and parachutes for pilot and passengers. For weather reporting, an emergency telephone service has been arranged.

Multi-engined equipment, complete weather service, adequate lighting, and above all, more traffic from American business, are the keynotes of success in this great new field.

A Record Long Distance Flight

THE Raymond Orteig prize of 25,000 dollars for the first non-stop flight between New York and Paris still remains to be won. Many individuals and organizations are considering ways and means of



The *Ryan M-1* monoplane used by the Pacific Air Transport Company on its line between Los Angeles, California and Seattle, Washington. This plane is typical of the smaller planes used on the various contract air-mail routes throughout the country. These are described in more detail in the text above

He may oil it without accident for many years ** **and Then—**

a careless moment. A single misstep. Or a ladder "that always was safe." Then serious accident or death.

Such things have happened for many years. Such things are happening today. And the fact that a similar catastrophe has not already occurred in your plant is no assurance that it won't occur tomorrow.

Arguto Oilless Bearings safeguard your employees and protect your profits and your property. A bearing that costs less than metal, and has a record of 22 years of continuous service without oil or attention, is well worth investigating—and installing. Write today.

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and have continuous heating comfort

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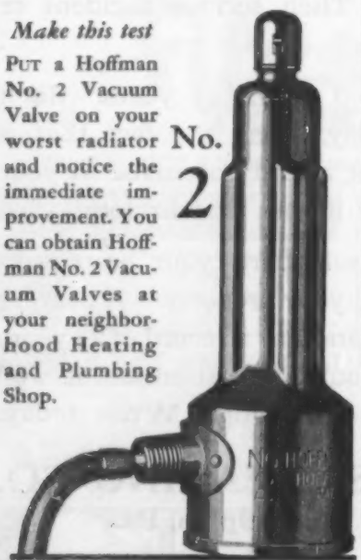
Send this coupon for an intensely interesting book "Locking the Door Against the Heat Thief."

Make this test

PUT a Hoffman No. 2 Vacuum Valve on your worst radiator and notice the immediate improvement. You can obtain Hoffman No. 2 Vacuum Valves at your neighborhood Heating and Plumbing Shop.



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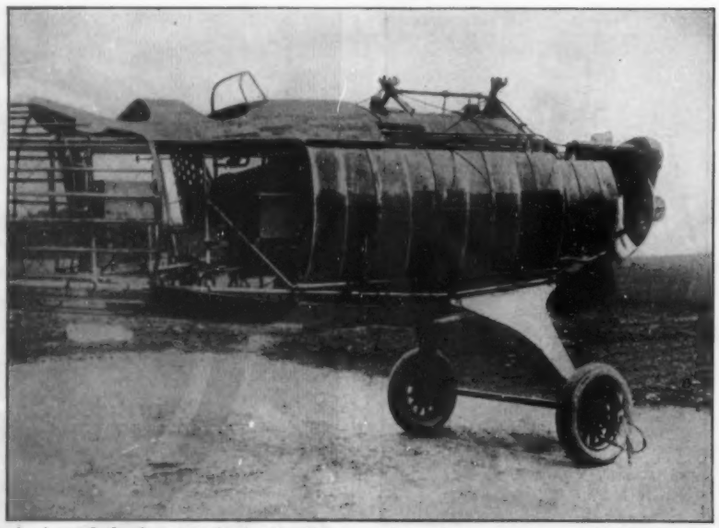


A view of the huge tanks in the Breguet plane that recently established a new non-stop record. These carry 800 gallons of fuel, enough for 3,720 miles of flight without unfavorable winds

achievement. Sikorsky made the fundamental mistake of loading his plane too heavily in relation to the wing area and the horsepower available. Perhaps he was driven to this by the very fact that he employed three engines. It is apparently possible to achieve a tremendous range without overloading, by the use of a single engine and smaller dimensions of the plane as a whole, at the expense of the security offered by the multiple power plant.

At any rate, R. C. Wood of Paris describes in *U. S. Air Services* a long-distance record flight of 2,920 miles made in a standard type Breguet plane by Captain Girier and Lieutenant Dordilly of the French Air Service. Apparently the flight was made with little preparation or fuss. Leaving Paris early on a Wednesday morning, the aviators arrived over Cologne in two hours, flew over Berlin and Dantzig in Germany, and then across the plains of Russia. Passing over the Ural Mountains, the Frenchmen encountered a five-hour electrical storm, which impeded progress and used up fuel. Nevertheless they landed in Omsk in Siberia after only 29 hours of flight, having maintained an average of 100 miles per hour.

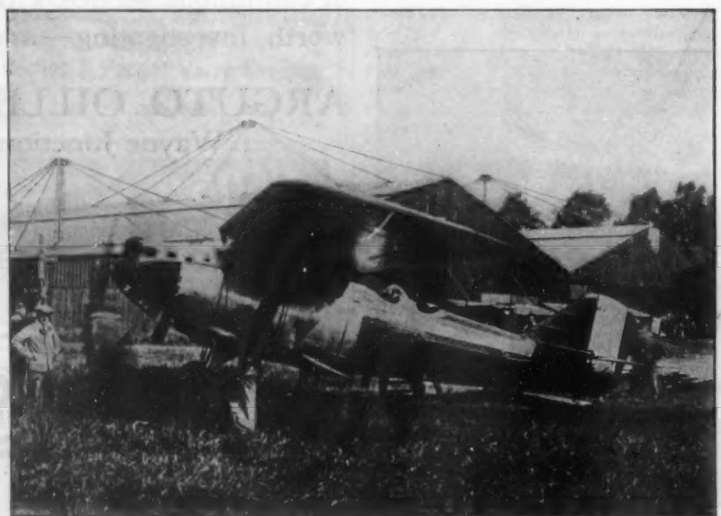
The flight teaches technical lessons of considerable value. The Breguet plane weighed 8,600 pounds, and had only 590 square feet of wing area, or a loading of 14.6 pounds per square foot. The engine, a 12-cylinder Hispano-Suiza, delivered 450 horsepower so that the power loading was 19.1 pounds per horsepower. The useful load (crew, gasoline, oil and sundries) was 5,550 pounds, or 64.5 percent of the gross weight. In spite of these tremendous loadings and huge useful load, and in spite of the fact that no auxiliary devices were used to make a get-away, no trouble was experienced in clearing the airdrome at Le Bourget or in climbing to altitude.

The average mail plane has a useful load of only 50 percent, a loading per square foot of wing area of something like nine pounds and a loading per horsepower of around 13 pounds. Perhaps what is now a record achievement in load carrying and endurance may in a few years become a commonplace practice. And yet the Breguet plane is not in any way an extraordinary design. It has a large body with good streamline form, and a very light metal structure, and is the result of many years of improvements of the same model.

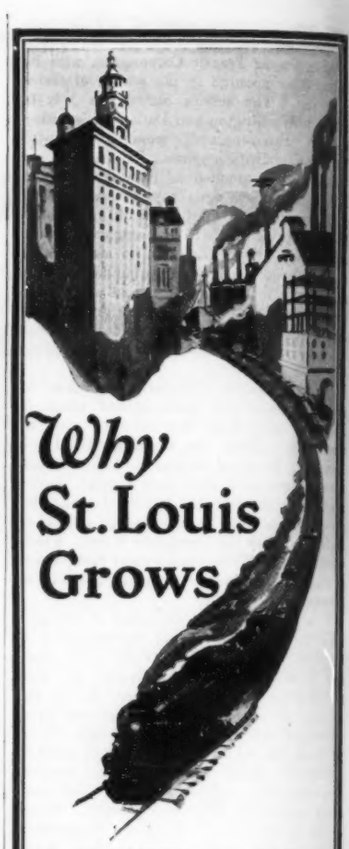
The *Langley*

OUR photograph on page 63 shows the aircraft carrier *Langley* with its great deck over 600 feet in length and 80 feet in width, absolutely clear and level except for the transverse arresting wires. Even the funnels are made to project sidewise and quite clear of the deck itself. The *Langley* was put into commission in 1924, and since then naval aviators have landed their planes on it 2,500 times without a single major accident. Of these landings 1,700 have been made since last November and mainly in the recent maneuvers of the Pacific Fleet.

The arresting gear employed is a jealously guarded secret of the American Navy,



The Breguet plane that made the record flight of 2,920 miles between Paris, France and Omsk, Siberia. The time consumed was only 29 hours, an average of approximately 100 miles per hour



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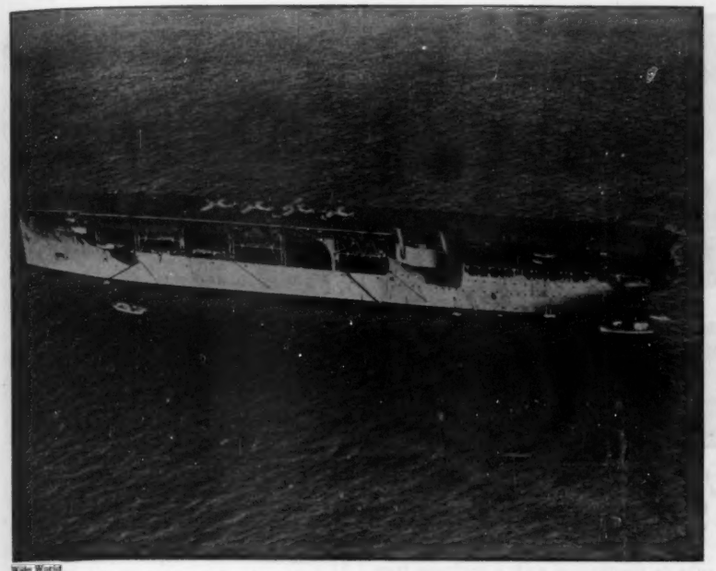


Wide World
The long, clear deck of the *Langley*, an airplane carrier, with four planes ready to hop-off. Note the stacks at the side

although why it should be so guarded is not very evident since every great navy in the world has its aircraft carriers provided with a similar gear. From our two photographs it is quite clear that the arresting gear involves a series of hooks mounted on the axle of the plane, which hooks engage with transverse wires on the deck. To prevent the airplane from landing by mishap on the lower deck, a shielding wire screen is carried. The Navy is said to have spent millions of dollars on the development of this arresting gear.

Unsolved Problems

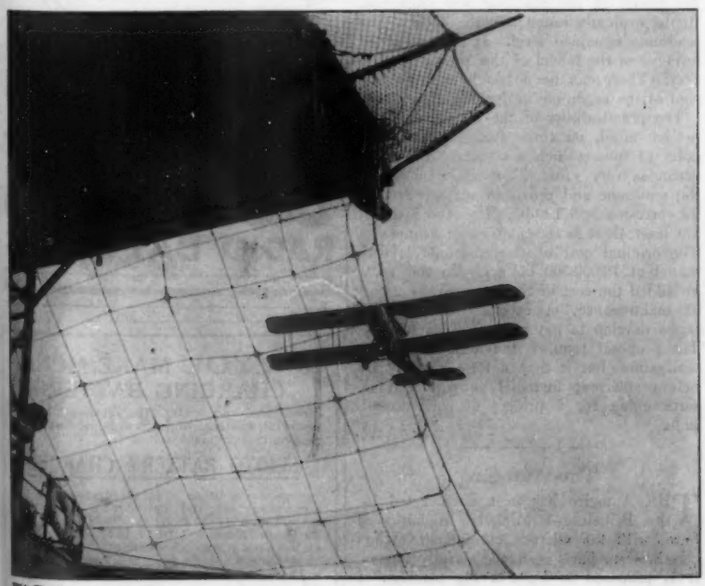
AERONAUTICAL engineering is comparatively young, yet airplane designers and constructors are so obsessed with routine calculations and design, and minor refinements, that they are apt to regard the airplane as having reached something like its final form. It is very refreshing therefore to have an engineer of reputation break away from standard conceptions. On October 12th, L. Bramson presented a paper of this character before the London Institution of Aeronautical Engineers, under the title "Unsolved Aeronautical Problems."

Full reports are not yet available, but some of the sub-titles are significant. The following examples are noteworthy.

"The Propulsion of Airplanes With Constant Power at Varying Altitudes." It is a well known fact that if the power of the engine is maintained in the rarefied air of the upper atmosphere, the speed of the plane increases considerably. Perhaps we shall some day fly in an air-tight, oxygen-supplied cabin at 50,000 feet altitude at speeds of over 300 miles an hour.

"The Propulsion of Airplanes by Means of Jets." In the utilization of the energy of our fuel, there is a double transformation at present; first, the heat energy is converted into mechanical work, then the mechanical work is converted into propulsion work via the screw propeller. In jet propulsion, the gases after explosion would issue from a suitably designed orifice and drive the plane through the air by simple reaction. The difficulty is that the jet issues at tremendous velocity, while the plane is moving comparatively slowly. There is a tremendous loss in the kinetic energy of the issuing gas, and the efficiency of the propulsive mechanism is low accordingly. If we could conceive of a flying machine traveling at 1,000 miles per hour and the issuing gases so entrapping a large volume of air that their velocity was not sensibly greater than that of the craft itself, great efficiency and simplicity would be attained.

"Variable Wing Surfaces." We have written in these columns of various devices calculated to reduce landing speeds, such as the Handley Page leading edge slot, the La



Wide World
The wire screen prevents planes from landing on the lower deck. The axle of the plane carries hooks, part of the landing gear

Every Buyer of heating equipment will be interested in these charts.

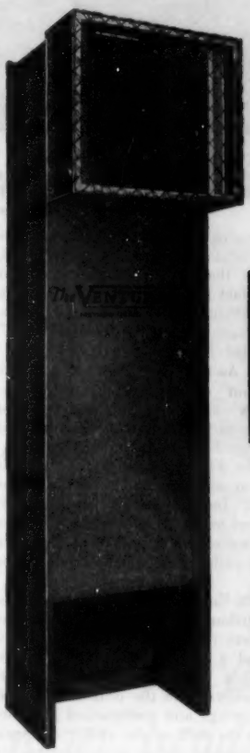
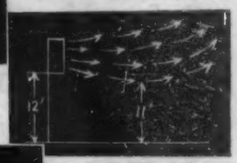


Fig 1—Shows normal position air takes in relation to temperature.

They are based on actual tests that show the flow of air from various types of heating equipment



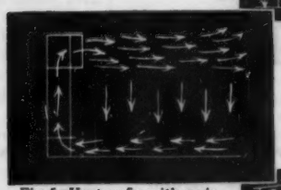


Fig. 2—Shows air blown through a unit heater without recirculating box at 400 ft. velocity.

✓ HEAT WITH UNIT HEATERS

Fig. 5—Venturafin with recirculating box forms a complete air circuit—draws the cooler air from floor—forces heated air out whence it drops to replace the air removed.

Fig. 3—Shows course taken by heated air from radiators, steam coils, etc.

Fig. 4—Illustrates the course of heated air if heater is mounted overhead facing the floor.

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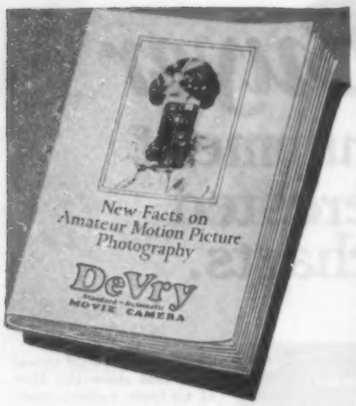

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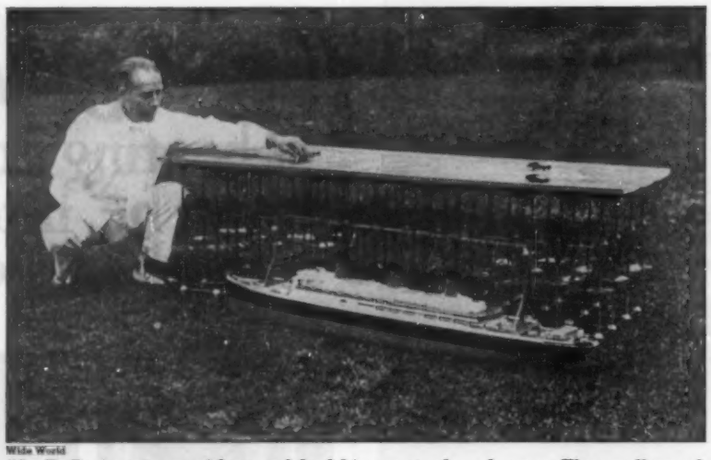

Wide World

Mr. E. R. Armstrong with a model of his proposed seadrome. The small vessel is a model of the *Majestic* which was used in tests that demonstrated the apparent practicability of the seadrome. The landing stage is designed to facilitate practical transatlantic commercial flying

Cierva Autogiro, et cetera. The variable-area wing, while mechanically complicated, might prove the most powerful means of attack. In fact it has already been tried in a French design with moderate success. Perhaps an airplane with "reefing wings" will some day be achieved.

"Vertical Ascent and Descent." There we have our old friend the helicopter. Vast energy and large expenditures of money have so far given poor results, but there may yet be a solution.

"Seaworthy Flying Boats." This appeals peculiarly to a sea-going people such as the British. Increase in size, metal hulls, water rudders and auxiliary engines in case of break-down of the main power plant are some of the paths along which seaworthiness lies.

"The Multi-Engine Room With Ideal Propeller Distribution and Without Engine Drags." There we suspect that Mr. Bramson has in mind a combination of several engines, working through clutches and gear-driven propellers, with the propellers placed out on the wings and undisturbed by body obstructions, as well as the ability to throw out of the system one or more engines for temporary repairs. This is certainly a problem which should not be beyond the scope of the mechanical engineer.

Mid-ocean Airports

THE recent disaster to the Sikorsky transatlantic plane may be indirectly attributed to the excessive overloading with the huge weight of fuel required for a non-stop flight from New York to Paris. Technical methods may be found of overcoming such troubles, but it is still more difficult to carry an adequate pay load in addition to an adequate gasoline supply. Dr. Rumpler is attacking the problem by designing the radically different type of aircraft described in these notes: E. R. Armstrong, an engineer of Wilmington, Delaware, is planning mid-ocean airports which will shorten the non-stop flight of a transatlantic seaplane to a few hundred miles. Aircraft carriers, under storm conditions, would never provide a sufficiently level deck for the conduct of a commercial service. Therefore, Mr. Armstrong introduces the idea of a floating structure not influenced by wave disturbance.

The proposed seadrome, illustrated by a photograph of the model, is to have a displacement of 15,000 tons, and a landing deck 400 feet wide and 1,200 feet in length, 70 feet above the normal sea level. Approximately 95 percent of the total displacement is below the maximum wave disturbance line, so that for all practical purposes, the structure would be floating in still water. Waves are much smaller than one would usually imagine and the greatest North Atlantic wave on record had an amplitude of only 42 feet, creating but little movement 50 feet below the normal surface of the ocean.

There seems to be no insuperable difficulty in constructing such a seadrome from an engineering point of view. According to calculations made by Mr. Armstrong, anchoring the seadrome is practical. The profile of a possible route across the North Atlantic shows that the anchorages must be made in water approximately three miles deep. In the proposed system, a 2¼ inch galvanized steel cable 27,600 feet long is to be used, having a 12,500 pound anchor attached to its lower end. The cable, hanging under its own weight, will assume a catenary curve in which the strains can be determined by simple calculation. The latter need, under no circumstances, exceed the breaking strength of the cable. At the surface end of the cable a buoy with a displacement about equal to that of the anchor is to be attached, so that the rise and fall of the ocean will submerge the buoy to a greater or lesser degree, heaving strains on the cable thus being avoided. A towing hawser, with a strength of 25,000 pounds and a length of 1,000 feet, will connect the station buoy with the seadrome. This hawser is to be used also in towing the seadrome out to the point of the ocean where it is to stationed. The cable curve will lengthen or shorten to a certain extent and allow the seadrome to drift a mile or so.

When demonstrating a scale model of the seadrome, the inventor created waves in a pond by means of a large hand-operated paddle, thus simulating conditions such as are likely to occur in actual practice. For comparative purposes, a dynamically similar model of the *Majestic* was employed. In the evidently rough sea, the deck of the seadrome remained level. It also remained level when the model of the *Majestic* rolled over. There can be no doubt that the design of the seadrome is dynamically correct.

The practicability of the system depends, to our mind, on three factors. The difficulty of towing such a structure into mid-ocean is very great. The maintenance of the seadrome and provision against damage by corrosion will be difficult. And last but not least, there is the question of economics. The original cost of the seadrome is estimated at 18,000,000 dollars. To this must be added the cost of routing buoys, the cost of maintenance, et cetera. Will enough traffic develop to pay the carrying charges? The proposal requires the most careful investigation, but it may not be many years before sufficient financial support will be forthcoming for a project of such magnitude.

The Autogiro

THE Autogiro has been constructed for the British Air Ministry in improved form, with the ailerons eliminated. When certain tests have been successfully passed, it is proposed to build a big machine of this type to carry passengers. It is to be equipped with two Napier Lion engines of 450 horsepower each.

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Fifth and King Ave. Columbus, Ohio

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Marconi Predicts Power Transmission

SENATORE Marconi in an address before the Institution of Civil Engineers in London predicted, with the hope that his audience would not consider him too visionary, that it may be possible some day to send electric power by radio over moderate distances by means of parallel beams in such a manner as to minimize dispersion and diffusion of the energy into space.

"I think we are still far from being able to say that wireless is based on well understood foundations, unless of course, we should go back to the arrangements used in the past which, to my mind have become more or less obsolete," said Senatore Marconi. "We are yet, in my opinion, a very long way from being able to utilize electric waves to anything like their full extent. This will be the work of future engineers, and with the continual advance of civilization it will become more necessary in the future than it has in the past."

The inventor of wireless pointed out that it is quite possible that cities may be lighted without the present elaborate system of wiring and that waterfalls may be harnessed and made to send the power generated to cities or factories without the use of expensive cables.

He paid tribute to the radio amateurs, declaring that their observations had often been of assistance to him. He warned, however, against taking their negative results too seriously, since generally they were not in a position to make exact observations.

Should Women Announce

A STATEMENT issued by the British Broadcasting Company contended that women are not efficient radio announcers because, "they are temperamentally less suitable than men and the physical strain imposed upon the announcer is greater than could be borne by the average woman."

Women's organizations in England protested. The leader of one association said, "It is preposterous to speak of announcing as a heavy physical strain. Surely it is not as great a physical strain as swimming the Channel or washing heavy blankets. How about our women teachers who have charge of large classes? They are announcing day in and day out."

Some Still Prefer Old Tin Horns

THE difference between the original musical presentation of a program and the program reproduced by a modern loudspeaker supplied by a good quality receiver and amplifier is so slight as to be unimportant, Harry Sadenwater, in charge of the technical operations of WGY, KOA and KGO, told the Radio Club of America.

"However, many people are still listening to tin horns, rubber horns and phonograph horns that do not deliver any frequencies below 250 cycles and any frequency above 3,000 cycles, and through being accustomed to listening to such reproduction feel quite happy and contented with their equipment," said Mr. Sadenwater.

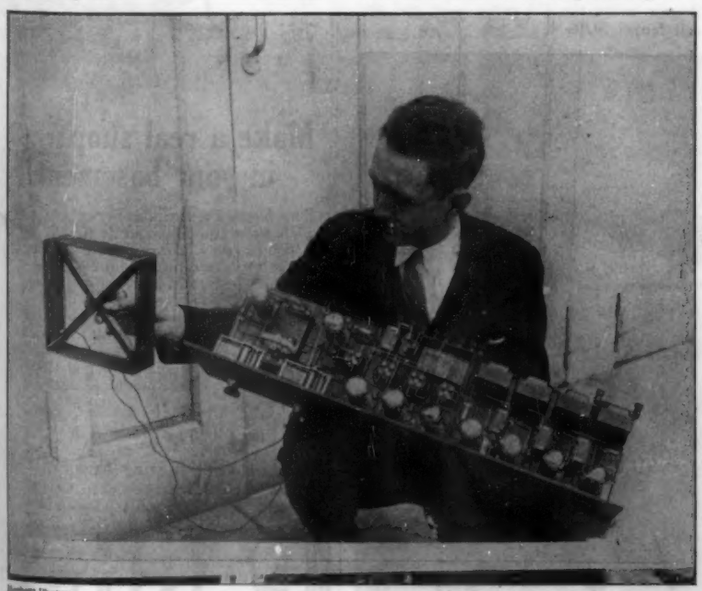
"It is rather difficult if not unwise, to advise such a friend that the reproduction of the radio program is horrible, and it is my experience that when a good loudspeaker is installed in such a home for comparison, the listeners will prefer the old horn-type loudspeaker to the good loudspeaker, because they are more accustomed to listening to what were formerly standard phonograph reproductions. The listeners will immediately complain that the new loudspeaker accentuates the low frequencies; but as a matter of fact, even though this is the first impression, when one listens to the original program in the studio there are more low frequencies present in the original performance than there are in this loudspeaker that is complained of as having too much low frequency."

Naval Radio Schools

THE United States Navy is operating two schools for radio men, one at the Naval Training station at San Diego, California, and the other at Hampton Roads, Virginia. The courses of study at both schools are the same.

In order to graduate, an operator must be able to receive and transmit the Continental Morse code at a speed of 15 words a minute, in plain language, numerals, code, or mixed letter and numeral code groups of five characters per group.

Each operator must demonstrate actual ability to take over a radio watch and copy the regular messages sent out by Washington over either the Arlington station or another naval station, before graduating.



Herbert Photos

The builder of this nine-tube super-heterodyne set, William Reuman of Woodside, New York, reports that he has picked up California broadcasts with the tiny loop which is shown to the left of the set

APPROVED BY 18 MONTHS OF PUBLIC USE
NO OTHER BATTERY IS LIKE IT

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.
No.486
EVEREADY
RADIO "B" BATTERY
Layerbilt
Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

Practical tests prove this new product to be the most economical of "B" *batteries*

IN DAILY use in the home, Eveready Layerbilt "B" Battery No. 486 has fulfilled the promises made for it in laboratory tests. More than a year's study of the performance of this battery in the hands of the public has shown that it is the most satisfactory and most economical "B" battery ever developed. All loud-speaker sets require Heavy-Duty batteries—and the Layerbilt has proved itself absolutely the best of them all.

If you are now using the smaller, Light-Duty batteries, the Eveready Layerbilts will give you twice the service, though they do not cost anything like twice as much. If you are already using Heavy-Duties, the Layerbilt, the longest lasting Heavy-Duty ever built, will run your set at least 25% longer, and again you will save money. Unless Eveready Layerbilts are connected to your set, you are spending more on "B" batteries than you should, and you can have no idea how good a "B" battery can be. The Layerbilt holds a surprise in store for you.

Eveready Layerbilt's unequaled service is due to its unique construction. All other dry cell "B" batteries are made of cylindrical cells, with many soldered connections, and a great deal of space is wasted between the cells. The Layerbilt is built up of layers of *flat* current-producing elements, that make connection with each other automatically, and that fill all available space inside the battery case. It is every inch a battery. In it you get more active materials than in any other battery and the Layerbilt construction makes those materials more efficient in current production.

Those are the reasons why the Eveready Layerbilt has proved itself the longest lasting, most economical and reliable "B" battery ever built.

Just remember this about "B" batteries—Heavy-Duty batteries are more economical than the smaller Light-Duty batteries on all loud-speaker sets, and the patented exclusive Eveready Layerbilt No. 486 is the most economical of all.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
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Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WTAG–*Worcester*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WTAM–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOC–*Davenport*
WCCO–*Minneapolis, St. Paul*
KSD–*St. Louis*
WRC–*Washington*

Here are a few who have made successes

$50 to $250 a Week as a RADIO EXPERT

If you're earning a penny less than $50 a week, **Clip Coupon Now!** Send for AMAZING FREE BOOK telling all about great new big-pay industry, Radio, and how I prepare you quickly and easily in your spare time at home for the fine jobs of this profession. Why go along at $25 or $35 or $45 a week, when you **could** earn $50 to $250 in the same six days as a Radio Expert! Hundreds of N. R. I. trained men are doing it—why can't you? **Send for Free Book giving all information.**

Look at the four pictures above—here are just four out of **hundreds** of my graduates who have gained fine successes in this new live-wire field. Graduate L. G. Biles (shown in center of experimental laboratory) is Editor of Radio Homes. John Fetzer designed and built the new 5,000 watt $100,000 Station at WEMC and is now Chief Engineer there; Keith Kimball operates the famous Daily News Station WMAQ in Chicago; T. M. Wilcox left a job as telephone superintendent when he finished my course, started his own Radio business, and reports "I made $70 in one day!" All these men recommend my training as the best way to success in Radio.

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My **practical, tested,** crystal-clear methods of training make it easy for you to learn quickly and easily at home in your spare time. No delay, no losing time from work, no scrimping or scraping to get your training this practical way. Under special offer **now open** I give you a fine outfit of apparatus to work on, free of extra cost with your course. Write today for Free Book, while you still have time to get the advantages of this offer.

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SCIENTIFIC APPARATUS CORP. Dept. 109 Milton, Pa.

Harris and Ewing—Wide World

E. B. Calvert, chief of the Forecast Division of the United States Weather Bureau, can now see how his own weather maps look after they have traveled through the air. He is shown with the Jenkins radio weather-map receiving set which has just been installed in the Weather Bureau

Seeing by Radio

JOHN L. BAIRD, television inventor, in a lecture on "Seeing by Radio," at a meeting of the Royal Institute of British Architects, told how the picture of a hand, when tuned in on a broadcast receiver makes a rattling sound; a face gives a softer note; and it becomes possible to recognize objects by their image sounds.

Each face has a characteristic note, and every facial movement causes the note to change in pitch. If a man nods or opens his mouth the tone is altered in the headphones of any one tuned in on the 200 meter wave of the televisor.

Radio Versus Sun Spots

ALTHOUGH no direct connection has been established between sun spots and the weather, according to Professor Harlan T. Stetson of the Harvard Astronomical Observatory, it has been known for a long time that the sun spots have marked electrical and magnetic effects upon the earth and that good long-distance radio transmission and reception does not thrive in the same market with sun spots.

Sun spots recur in regular cycles of about eleven years. The last maximum occurred in 1917, while 1928 will mark another maximum. It is expected that the solar storms will increase in number and size for the next two years. Some of the disturbed areas are reported by astronomers to be 100,000 miles in extent.

Intensity of radio signals is believed to be affected by sun spots according to the observers at the Bureau of Standards. In 1922 the bureau's research laboratory began a study of long-wave, long-distance signals with the aim of establishing connections between the changes in signal intensity and natural phenomena in meterology such as terrestrial magnetism, solar activity and static. Ten stations were measured twice daily during 1925. Seven of these stations were in Europe, one in California, one in Porto Rico and the other in Argentina.

According to a report recently issued by the bureau, it has been established that there is a considerable relationship between radio signal intensity and temperature, especially for transmission over moderate distances, when weather conditions are fairly uniform over the path of transmission. It is also certain that the more severe magnetic storms affect the Hertzian waves, sometimes strengthening them and at other instances making them weak.

Airplane Sets

THE Army Air Service is equipping airplanes with super-heterodyne receivers, which, complete with batteries, weigh about twenty pounds. Seven tubes are used.

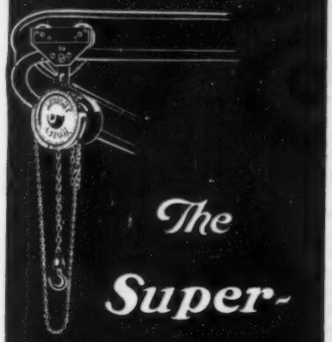
Brazil on the Air

A NEW broadcasting station located at Sao Paulo, Brazil, and owned by the Sociadade Radio Ecuadora Paulista is now on the air, using the 450 meter wave and the call letters SQIG.

Herbert Photos

Station WWRH, at Woodside, New York, is installed in a private home with the studio in a living room. The power rating is 500 watts

WRIGHT HOIST



The Super-Hoist

WRIGHT MANUFACTURING COMPANY LISBON, OHIO.

A new Parks! Cabinet Shop Special No. 10

$290

Make a real shop in your basement!

This handy Parks woodworker is complete shop equipment in itself. With it you can do all sorts of cabinet work. Make toys, furniture, radio cabinets—anything. Built for close, accurate work, yet small enough to fit in a corner of your basement. Operates from light socket. Has motor, rip and cut-off circular saw, jointer, and band-saw. Add lathe and shaper at slight extra cost. A real machine ideal for home use.

Send for circular

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1552 Knowlton St., Cincinnati, Ohio
Canadian Factory: 206 Notre Dame East, Montreal, Canada

PARKS WOODWORKING MACHINES

1,260,000 Radios in Germany

GERMANY has more than 1,260,000 radio-set owners and each one is required to pay 50 cents a month for the privilege of listening. The mail carriers collect the fees and the money thus raised goes to the government for the promotion of broadcasting, and if anything remains, it is used to reduce taxation.

German broadcasting stations are managed by private interests under licenses issued by the Post Office Department.

All who appear before the microphone are paid, a considerable part of the fund derived from the license fees being devoted to this purpose. Even lecturers from the universities and other institutions are compensated for broadcasting.

The German stations have adopted a policy of selling time on the air for direct advertising purposes. Such advertising is in the form of hints to buyers, and is generally given in the morning or early afternoon. It is reported that many listeners are interested in the announcements made during the advertising periods.

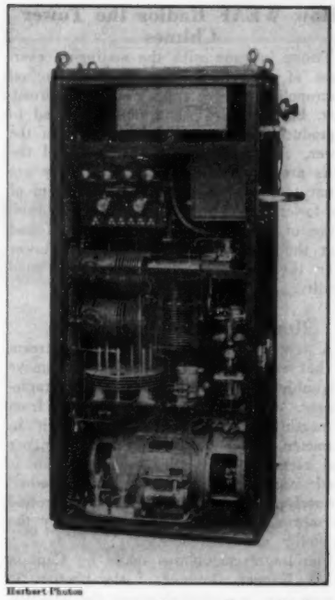
Few German listeners strive to tune in programs directly from other countries because foreign programs of importance are detected by a special receiver located outside of Berlin and are rebroadcast by the German transmitters.

Flag-dotted Maps in British Studios

THE studio of station 2LO, London, and each of the provincial broadcasters has a large map dotted with varicolored flags, which represent the quality of transmission from day to day as reported by listeners throughout the British Isles. Tests are conducted at frequent intervals and listeners previously receive warning of what is going to be done. All reports of praise and criticism are carefully tabulated and arranged on a regional basis. They are then translated into flags on the map, so that a glance discloses how reception varies in different localities. This affords a constant and accurate indication of the quality of service which broadcast auditors receive.

Tubes Versus Arc

VACUUM-TUBE transmitters are replacing the spark and arc apparatus in the United States Navy, because of higher efficiency, lower operating costs, and because of a desire to reduce interference to broadcast listeners. The arcs have been the objects of many complaints because of the "arc mush" and harmonics emitted. For example, the Annapolis transmitter located a few miles from Washington is closed from eight to ten o'clock every evening to clear the air for broadcast listeners. Annapolis has two arc transmitters rated at 300 kilowatts, and, except for this silent period it is on the air almost continuously. Naval engineers point out that with the installation of a vacuum tube transmitter, the station could be operated 24 hours without disturbing broadcast listeners.

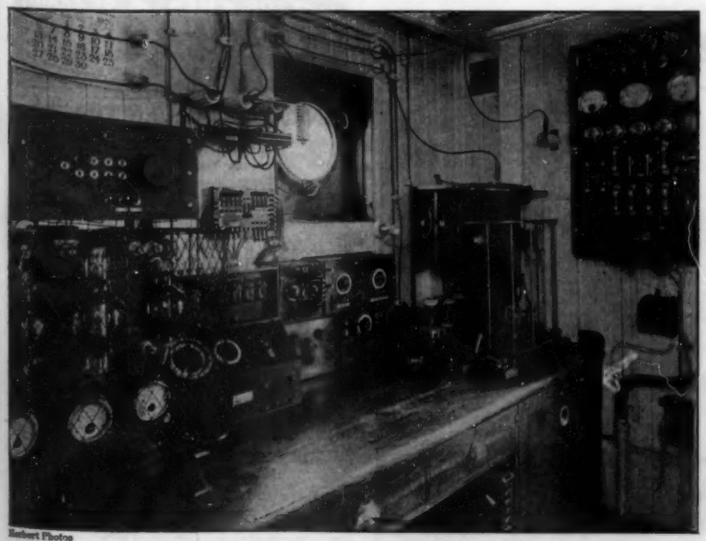


Herbert Photos

A marine transmitter. One of the latest Marconi devices built compactly for ships. The power output is 500 watts

Tests have shown that an 80-kilowatt tube station will deliver more current to the aerial and will have greater communication effectiveness than the 300-kilowatt arc. It was also found by naval radio engineers that after deducting, as an operating charge, the cost of the vacuum tubes used, the tube set would pay for itself through saving in power in less than two years. It was explained that this was brought about by the fact that the tube transmitter, due to its higher efficiency, draws approximately only 150 kilowatts, when the sending key is depressed, and only about 20 or 25 kilowatts when the key is up, which is estimated to be about two-thirds of the time.

This is a marked contrast to the arc transmitter, which is said to consume about 300 kilowatts, and this consumption is for all of the time the installation is in operation, regardless of whether the key is up or down. The only energy consumed by the tube transmitter, when the key is up, is for lighting the filaments of the vacuum tubes.



Herbert Photos

An ocean liner's radio voice. On the left is the 1,500-watt vacuum-tube transmitter of the transatlantic liner *Minnetonka*. Next is the radio compass, then a receiving set, and in the corner is an emergency transmitter

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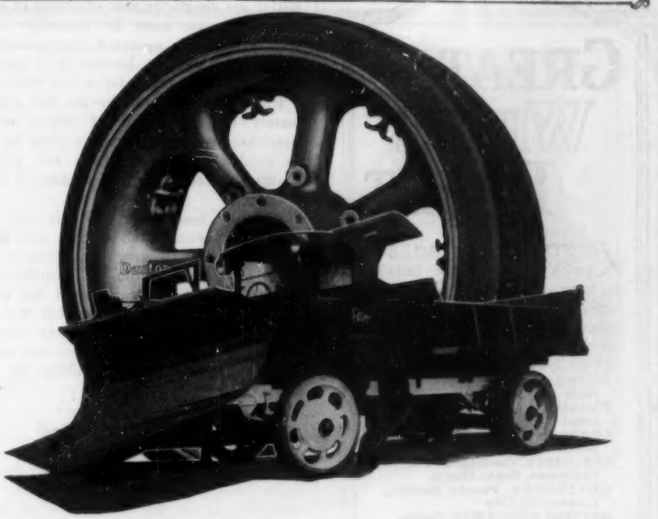

Walter *uses* DAYTONS

WALTER SNOW FIGHTERS are used for clearing snow and ice from city streets and highways in Northern United States and Canada.

Terrific power and traction is needed to clear away snow and ice without stalling or side-slipping.

Walter uses Dayton Steel Wheels built for four wheel drive. They help the truck to develop its maximum speed and traction.

Nearly all leading truck makers use Dayton Steel Wheels. Specify them.

Deliveries are timely and steady

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The Kay-Brunner Steel Casting Co. of Los Angeles is the exclusive manufacturer and distributor of Dayton Steel Wheels, west of the Rockies.

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Dayton
The Mark of a Good Wheel

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Replicas of the famous old
LIBERTY BELL
Lamp 4 1-4 inches by 6 3-4
Just the thing for the Boudoir, Radio Set or Table.
Lamp $4.00—Dinner Bell $2.75
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"UNISOL" chemically perfect feed-water treatment. Our new pamphlet on correct methods of treatment should be read by everyone interested in steam plants. Mailed on request.
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Amazing New Auto Gas Saver. All Makes. Direct Factory Distributors wanted everywhere. Exclusive. I FREE TO INTRODUCE. CRITCHLOW, Inventor, A-864, Wheaton, Ill.

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NOTE: This offer is made to prospective buyers by famous big Kansas Corporation, sole of America's oldest reliable manufacturers of fine sets—a record successful year. Many satisfied users in every state. Postal or coupon brings testimony of nearby users and proof Miraco's outperform sets costing up to 4 times as much. Very easy to operate
BEAUTIFUL-BIG-POWERFUL
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Built to look like and perform like a $200 set. Users report!
Beautiful Hand-rubbed Solid Walnut Cabinet
ONE DIAL CONTROL Only One Dial to turn for all programs.
28 in. Long
Users report Miraco Radios get programs Coast to Coast, also Canada, Cuba and Mexico, loud and clear on speaker; outperform $100 to $200 sets. Some have heard Europe, S. America. Don't confuse Miraco with small cheap sets. Unless trial proves IT MOST SELECTIVE, CLEAREST TONED and MOST POWERFUL DISTANCE-GETTER among beautiful big 5-tube sets, don't buy it. Beauty Miraco comes completely assembled, rigidly tested and fully guaranteed.
Our Factory Prices Save You Up to 1/2!
SEND NO MONEY! Save or make much money on sets, speakers, tubes, batteries—write for AMAZING OFFER. Ultra-5 (not Ultra) is marvelous value in a big Guaranteed 5-tube, 3-dial set: Retail List $49.75
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SPECIAL WHOLESALE PRICES to near-agents who show the set to friends.
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BRITISH HONDURAS, Belize
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Calm, sapphire seas; temperature 'round 80 degrees; and the pleasure of visiting new peoples, new lands, where graceful palms and the perfume of Cape jasmine make you forget northern winters.

Plan your winter vacation now! On a Great White Fleet Ship. You will enjoy the fine personal service which makes *every passenger a guest*, and luxurious beds, excellent food and the joy of living in a spacious outside room will all contribute toward making your cruise pleasurable.

Twice every week in the year Great White Fleet Ships sail from New York and New Orleans to the tropic fairylands that encircle the Caribbean. Cruises last from 11 to 24 days according to the route selected. Make your reservations early, for travel southward is going to be unusually heavy this year.

Write for illustrated booklet and folders to
Passenger Traffic Dept.
UNITED FRUIT COMPANY
Room 1639, 17 Battery Place
New York City

Other points in favor of the tube transmitter are simplicity and quietness of operation. The arc must be manually started and is generally operated continuously for considerable periods, because it is impracticable to shut it down for a few minutes at a time. Furthermore, the arc has approximately 60 relays, all of which operate simultaneously. These relays must be kept in good operating condition and accurate adjustment as otherwise a ragged signal results.

The tube transmitter has only one relay, carrying practically no current and having no sparking to destroy the contacts. Another advantage of the tube equipment is that it can be easily arranged for remote control, not only for keying, but for starting and stopping. This means that the naval operators in Washington can control the Annapolis transmitter, about 30 miles away.

Tower Dismantled

THE main aerial at the Great Lakes Naval Training station has been dismantled, because of the progress of short-wave transmission. Traffic previously handled by the 30-kilowatt installation is now broadcast by a 200-watt short-wave set, the results of which have been so good that it was considered safe to take down the big mast. The short waves have been found to be more economical through saving in power, in tower maintenance, and in aerial and current cost.

Radio Patents

THERE are 256 unexpired patents in the vacuum tube field, covering everything from the relation of the grid to the plate; to the use of thorium in making of the tungsten filament, and the various methods of exhausting the air and gases from the bulb, according to a survey made by *Radio Broadcast*.

"The critical radio patents of today are not the critical patents of a few years ago," says the report. "With the rapid advance of the science, the control of the basic idea does not rest in the basic patent, but in the patent upon some more recent refinement of the basic idea, or upon some new method of manufacturing the device. In the process of refinement, the advantage is all on the side of the large corporation as against the small independent company or as against the individual inventor."

Station WRC Fed by Two Chains

STATION WRC, Washington, D. C., acting as a pick-up point for WEAF and WJZ is the only station in the country that is fed programs by two chains of stations. Programs originating at WEAF and WJZ are sent over land wires to the Washington station.

How WEAF Radios the Tower Chimes

THOSE in tune with the setting-up exercises of WEAF do not hear the actual Metropolitan Tower chimes open the broadcast, but a set of small bells designed to reproduce the tone of the big ones in the tower. The volume is much less and the bells are located in the studio. They are connected with the electrical mechanism of the tower chimes so that absolute synchronization of chiming is obtained. It was found that the microphone placed in the tower near the big bells did not render good quality.

Removing the "Freckles"

A NEW thermic process, utilizing a stream of hot air, has been developed to remove the objectionable "freckles" from radiophotos. A tiny stream of hot air shot from a nozzle five-thousandths of an inch in diameter strikes a specially treated paper and records the picture. This system is used instead of the pen-and-ink method formerly used. The flow of air is controlled by means of a small valve operated by the incoming radio impulses.

The improvement was made by Captain R. H. Ranger, inventor of the photo-radio system now in operation across the Atlantic.

Radio Literature

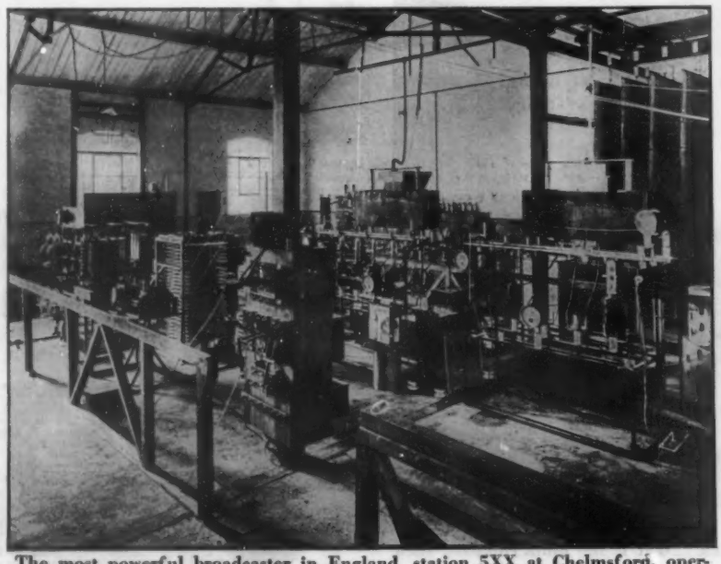
ALL recent literature on technical radio has been compiled by the Bureau of Standards in a form known as Circular Letter 207. The subjects covered are: radiation; transmission phenomena; fading; daily variations; seasonal variations; directional variations; ionization; Heaviside layer; reflection, refraction and diffraction of waves; transmission theories; formulas; range; effect of eclipse; static and measurement of signal intensity.

The Olive Branch

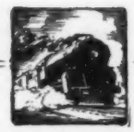
THE controversy between broadcasting stations and musical copyright owners is near a peaceful settlement according to E. C. Mills, chairman of the administrative committee of the American Society of Composers, Authors and Publishers. "The musical copyright owners are practically at peace with the broadcasters," said Mr. Mills. "It is estimated that in 1926 not less than 250,000,000 dollars worth of radio apparatus was sold. At present rates of license fees charged, broadcasting stations musical copyright owners will receive about 200,000 dollars."

Navy Stations Busy

UNITED States Naval shore communication facilities handled 77,000,000 words during the past year, which is 4,000,000 more than last year.



The most powerful broadcaster in England, station 5XX at Chelmsford, operates on the 1,600-meter wave and is rated with an output of 25 kilowatts



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SAILING DATES IN EVERY ISSUE

For the convenience of our readers we will publish each month the sailing dates for Europe and other countries together with the dates of special tours and cruises.

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Somebody Is Wrong

From the Scientific American, November, 1926, page 357: "To demonstrate that the charm of the pearl is only a surface effect let the outer layer of one be peeled off: the pretty gem will become a dull, uninteresting pebble of limestone."

From a letter written by Richard Wormser, importer of pearls, New York:

Editor,
The Scientific American:

On page 357 of your current issue, you print some very interesting photographs of the pearl fisheries. It was somewhat of a shock, however, to one who had come to regard your periodical as a source of accurate scientific information to read the comment which appears below the pictures.

Your writer states that the lustre and iridescence of the pearl are caused by the effect of its minutely corrugated surface on light. If this were true, a peeled layer of a pearl would present as brilliant an appearance as the pearl from which it was removed, which is not the case. Pearls are formed like an onion, of concentric layers around a minute nucleus of sand or other foreign matter. By a combination of reflection and refraction, light in passing through the successive layers, gives the pearl its lustre and brilliance. It is for this reason that, advertising writers to the contrary notwithstanding, no imitation pearl has yet been manufactured which would deceive anyone who was familiar with the genuine article. It is the effect produced by the refractive and reflective qualities of light which has not been imitated.

Your writer's statement that, if the outer layer of a pearl be removed, the pearl will be nothing but a dull pebble, is absolutely untrue. When the outermost layer is removed the balance will present the same appearance as before. As a matter of fact, it is often possible to remove the outer layer of a pearl when its skin is defective and find the next skin to be perfect.

Should you be interested in going into the matter any further, I can refer you to the "Book of the Pearl" by Kunz and Stevenson, which is the most comprehensive work on the subject which has been published.

I am bringing this to your attention as I do not like to believe that you would want misinformation of this kind to go uncorrected.

Very truly yours,
Richard S. Wormser.

We have also received letters similar in tenor to the one quoted above, from the Crossman Company, New York; the Keystone Publishing Company, Philadelphia; and the National Jewelers Publicity Association, Newark, New Jersey.

From the Encyclopaedia Britannica, Eleventh Edition, Volume XXI, page 25, article entitled "Pearl":

"Sir D. Brewster first showed that the iridescence of this substance was an optical phenomenon due to the interference of rays of light reflected from microscopic corrugations of the surface . . . " Also: "On removing the outer layer of a pearl the subjacent surface is generally dull, like a dead fish-eye."

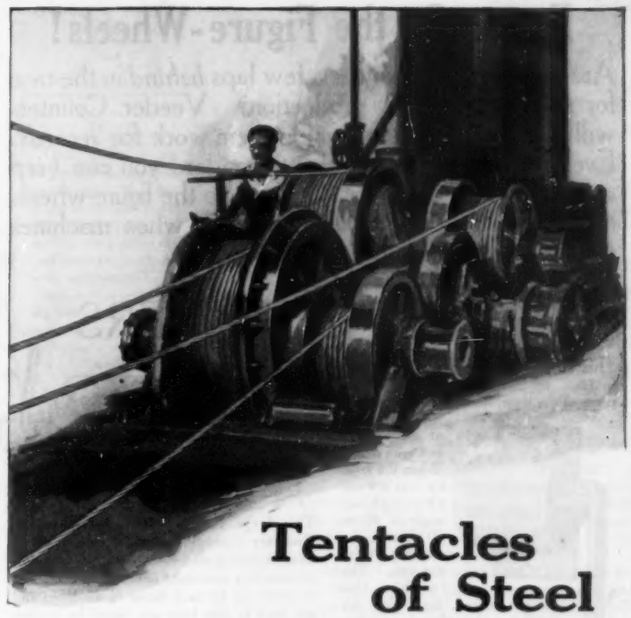
Thirty-power Telescope for Thirty Cents

In making any piece of apparatus at home there is a satisfaction in seeing how far one can make picked-up materials suffice for purchased materials. Mr. Franklin W. Smith, of 407 South Scott Avenue, Glen Olden, Pennsylvania, sends us the description of a reflecting telescope having a four-inch mirror, which he made for a total of 30 cents. Who can beat that record! Mr. Smith writes as follows:

Editor, Scientific American:

I enclose the photograph of a reflecting telescope which I made after I read your book, "Amateur Telescope Making." While this instrument is smaller than the one suggested by Mr. Porter, its performance has been quite satisfactory. Excellent views, especially of the moon and Jupiter with its satellites, have been secured.

Mr. Smith's telescope is as good as any for some purposes



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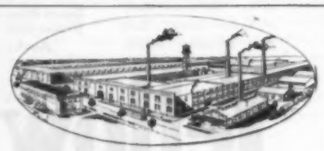

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KOKOMO INDIANA

The material for this instrument, exclusive of the eyepieces which were obtained from an old microscope, cost but thirty cents. The glass disks, which were less than four inches in diameter, were cut from scraps of plate glass. These disks were ground with grinding compound such as is sold for valve grinding. The rough grinding was done with this compound just as it came from the can. After each charge of this had been ground down until it no longer cut, the remaining coarse particles were removed from the exhausted charge and were set aside for use in fine grinding. (This method of preparing abrasive for fine grinding is described in Draper's paper in the "Scientific American Supplement" for July-August 1905.) The rouge for polishing and figuring the mirror was prepared by heating iron sulfate.

This mirror has also been used with some success in a Herschelian mounting.

Franklin W. Smith.

The Undertow—Is It a Myth?

That the various issues of the Scientific American are commonly treasured up and reread long after publication is well known to the editors. Recently we visited a public library in a community of 6,000 population and were agreeably surprised to find a stack of Scientific Americans, running back several years, worn, thumbed and dog-eared, but with their back covers bearing the imprints of many date stampings, indicating how frequently they had been loaned out to readers. One of our subscribers who has been reading his back issues contributes to a discussion which, even if not very recent, is as interesting now as it was a year or so ago. In the issue of August, 1925, page 124, Dr. W. M. Davis, noted Harvard physiographer, claimed that the steady undertow of the sea-beach was a myth. Mr. Meyer Berman answered this claim, in the issue of November, 1925, stating that the undertow is not a myth. And now Prof. W. H. Pickering, well-known astronomer stationed in Mandeville, Jamaica, B. W. I., also takes up the cudgels to disprove the original statement that the undertow is a myth. His letter follows:

I have just been reading a letter by Mr. Berman on this subject in the Scientific American for November, 1925, page 346, and, feel impelled by it to write a description of a personal experience. I have always swum easily, and rather rapidly in an amateurish way. I have been swimming now for well over fifty years, many times and in many places, both in the Atlantic and the Pacific, in the torrid as well as in the temperate zone, but had never until recently encountered the undertow. I was therefore inclined to agree with Professor Davis about it. It is certainly not a common phenomenon as far as my experience goes, although it may be common enough in certain particular spots.

A few months ago I took some of the younger members of my family for a swim on the southern coast of Jamaica. It was a bright calm sunny day, but when we reached the beach we found a fairly heavy surf, the interval from crest to trough of the rollers ranging in height from fifteen to occasionally perhaps thirty inches. I mention this fact since it implies a stiff breeze somewhere off the coast. I had been there before when the surf was higher, and would easily knock a man down if he was in water of a certain depth, and I had also been there when the waves were but little more than a ripple upon the surface.

But this time I noticed something different from usual. On entering the water we encountered a gentle current drifting us slowly along the beach towards the west. It was not at all swift, as in many rivers where enjoyable swimming is quite possible, but its effect was nevertheless quite noticeable, carrying us along perhaps some 200 yards or more in the course of a half hour.

At the end of that time I suddenly noticed that something different was happening, for I was gradually being carried out to sea. I was not at all disturbed, for I could easily swim against the current, indeed it would be only a very weak swimmer who would have been troubled by it, but the existence of the current was now clear and unmistakable, and I thought to myself, "here at last is the undertow."

Had I been further from shore it is possible that the current would have been swifter, and I certainly should not have noticed its result as quickly as I did. Also it is to be noticed that it was a uniform surface current, and that the name undertow seems to be a misnomer. It had no direct connection with the high surf, although both were coincident, and probably due to the same cause—a stiff breeze outside. That its effect was the same, and that it was insidious, and not readily detected until you were well within its grasp, were the only resemblances it bore to the supposed characteristics of the dreaded undertow.

Turning now to Mr. Berman's explanation in the November, 1925, Scientific American, it is very clear what had happened. An unusual current had set in from the sea. In his figure we had entered the water at B', had been carried westerly by the current along the beach, and I had now reached the point C', where I was being gradually swept out to sea. A current that comes in from the sea must go out again.

Mr. Berman's paper is important, but he fails to draw the moral, which I had not myself seen until I read his article. If on entering the water you find a current, apparently quite harmless, but gradually carrying you along the beach, if you are not a swimmer, you had better get out at once. If you are a swimmer do not allow yourself to drift with the current, but work up against it. Then you will at least be on the safe side.

I did not know this rule when I took this swim, and I do not believe that it has ever been published before, but now that we have the explanation of the so-called "undertow" the point is quite evident.

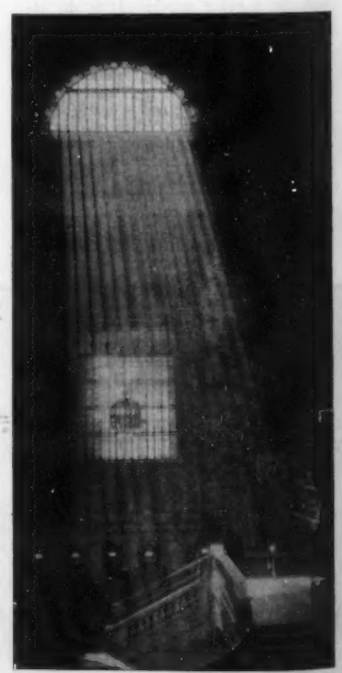
W. H. Pickering.

Photographing Sunlight

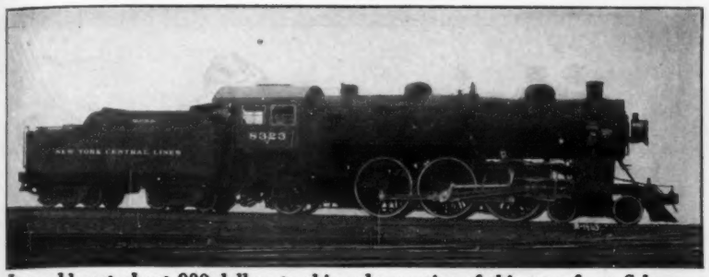
One of our younger readers has forcibly demonstrated the fact that the camera can often see more than the human eye. He did this by taking the photograph reproduced in these columns. His letter, printed below, gives all the details.

Editor, Scientific American:

The enclosed photograph was taken



The reflection of sunlight from dust particles in the air is strikingly illustrated in this exceptional interior photograph



It would cost about 900 dollars to ship a locomotive of this type from Schenectady to St. Louis in the manner described below

in the Grand Central Station, New York City, at 1:30 P.M., on August 13, 1926. I think it is unusually interesting because it shows the sunlight reflected from the dust in the air much better than did the human eye at the same moment as the picture was taken.

The camera used was a 3A kodak with an f. 7.9 lens. This was stopped to f. 22 and an exposure of one second was given.

Very truly yours,
Fred B. Waddell,
New York City.

Delivering a Locomotive

Some of our readers have asked how much it costs to deliver a locomotive. The statement that it depends on weight and distance is not satisfying, so we determined to get an authoritative statement from one of the leading manufactures. Mr. A. M. Hamilton, Assistant Vice-President of the American Locomotive Sales Corporation has satisfied our curiosity and will, we feel sure, satisfy yours. Mr. Hamilton says:

"I would say that we ship engines dead in lots of one, two or three. The cab of one engine is always prepared for the use of the messenger who accompanies the engines. The cab being fitted with a bunk and a small sheet iron stove, so that the messenger has a place to sleep, keep warm, and if he wishes to do so, cook his meals. If shipped in lots of two or three, the other engines have the cabs securely closed and all tool equipment accompanying the engine, except such as the messenger may need en route, is placed in one of the cabs. The main rods have to be removed from all engines, and after being thoroughly protected with a grease covering, are loaded on the tank. The crossheads are blocked in position and the eccentric rods are also removed. All journals and bearing surfaces are thoroughly lubricated before the engines leave our works.

"The cost of shipment, of course, depends on the size of the locomotive. I am sending a photograph of a large passenger engine on which the freight charges from Schenectady to St. Louis would be about 900 dollars, or from Schenectady to Cincinnati about 600 dollars. The cost of messenger service to accompany a locomotive averages about 18 dollars per one hundred miles. If two or three engines are shipped together and taken care of by one messenger, the cost per engine is greatly reduced. It costs about 20 dollars per engine to prepare a locomotive for shipment. This charge covering the boxing of the cab, removal of main rods and of center rod and packing of all journals, together with enough oil and grease to supply the engine to its destination.

"In preparing engines for shipment abroad, the usual practice is to assemble the engine and test it under its own steam, after which it is taken apart and packed in wooden boxes for ocean shipment. In some instances where the unloading facilities at the port of destination will permit, locomotives have been shipped completely assembled, which saves the cost of re-erecting the locomotives by the purchaser when they are received. The ocean freight rates for this method of shipment, however, are very much higher than for engines knocked down and packed in the usual way."

We also find from the Hon. John J. Esch, Interstate Commerce Commission, that the rule is "actual weight less 50 percent with a minimum weight charge of 36,000 pounds, each, fifth class." Commissioner Esch also states that the man in charge must pay full fare except when he is a railroad employee holding free or reduced transportation. All expenses of the crews and all expenses for oil, waste and repairs, incident to the transportation of locomotives and tenders on their own wheels, are in addition to the rates and are at the expense of the owners. Thus, one subject for discussion can be definitely filed away as settled—new locomotives going to work do not travel under their own steam.

Answered

Where the swallows nest in winter has been solved, at least in part, by one of our readers who has been stationed in several southern localities, with the United States Army in which he was a lieutenant;

Mr. Orson D. Munn,
Editor, Scientific American.
My Dear Sir:

Regarding an article in the October, 1926, Scientific American, "Where Do the Chimney Swifts Go in Winter", also some time in 1913 I read an article in the Scientific American on the same subject. I would state the following facts: I served 24 years in the United States Army and most all of it in Cuba and Florida. During the first intervention in Cuba I was stationed at the old Spanish Barracks of Santa Cristina here in Matanzas from 1899 to 1902 and noted that the swallows nested every winter in these barracks.

In 1905 I was transferred to Key West Barracks, Florida, and noted that the swallows wintered there. I came back to Cuba in the second intervention in 1906 and was stationed at the same Santa Cristina Barracks during the winters of 1906-'07; '07-'08; '08-'09, and the swallows nested there every winter.

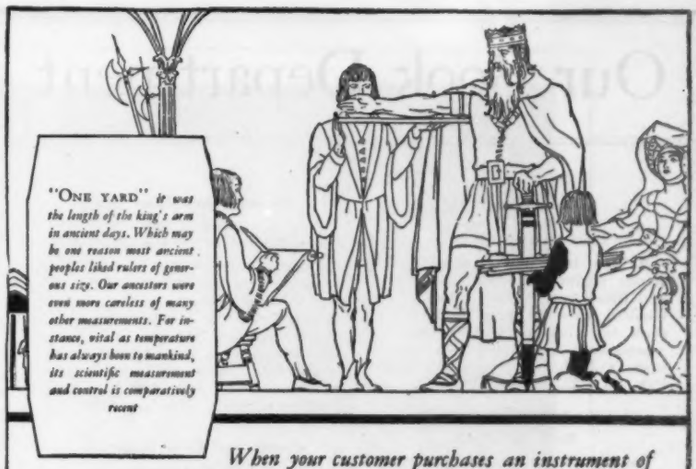
I was stationed at Fort Dade, Egmont Key, Florida, during the winters of 1909-'10; '10-'11; '11-'12, and noted that the swallows passed through every winter going south in large flocks, and at night the trees were loaded down with them.

I came back to Key West Barracks, Florida, in 1912, and was stationed there the winters of 1912-'13; '13-'14; '14-'15; '15-'16. Some swallows wintered there every winter, but did not nest. I also noted that the cats caught the birds in the following manner: the cat would lie down on the lawns or parade ground and when the swallow came flying low to catch bugs, the cat would stick up a paw and catch the bird and get it every time.

I was retired in 1921 and came back to Cuba, and in my quarters here at the Pilot Station the swallows have nested every winter. At present nine nests are in my house, but another thing happens: the swallows leave some years on November 1st. This year they left about September 11th, but they come back in a month or two. Where do they go to from here in those two months?

If I find any of the birds with identification tags on I will send same to you.

Very Respectfully,
Louis R. Hamill,
Apartado 182,
Matanzas, Cuba.
1st. Lieut., M.A.-O.R.C.,
Warrant Officer,
retired, U. S. A.



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L. S. Treadwell
Editor

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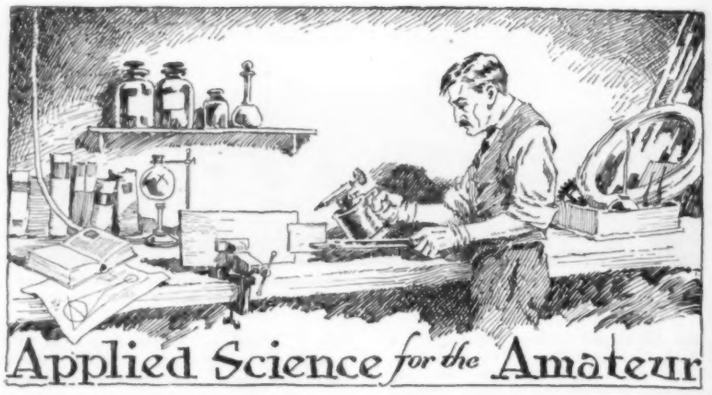


Applied Science *for the* Amateur

A department devoted to the presentation of useful ideas wherein will be found material of practical value for those who are mechanically inclined

Conducted by A. P. Peck

With this issue, we present the second appearance of this department. In it, we publish practical hints and kinks, formulas and processes and ways of doing things that are new, unusual or of particular value. To make this department of the greatest value to all, we invite our readers to contribute. Read the items in the columns below and then try to help your fellow readers by sending in some material that you think will be of general interest. We will pay for all articles that are accepted. Rejected items will be returned promptly, when stamps are enclosed. The success of this department depends on you. Let us know what you think of it and be sure to do your part by contributing. If you can suggest any way in which these columns can be improved, do not hesitate to do so

Heat and Batteries

DURING the winter months, there is always a possibility that the "B" batteries of a radio set may be placed near a radiator. This is poor practice when we consider the internal and mechanical structure of the batteries. In the first place, a dry battery is not truly dry. Its action depends on a certain amount of moisture inside each cell. Heat will tend to dry out the cells and when this happens, the battery will cease to function. Of course, every effort is made by the manufacturers to seal the cells so that the moisture cannot escape, but a hot radiator will often melt the sealing compound and so allow evaporation to take place.

If you want your dry batteries to give the best possible service, keep them away from excessive heat.

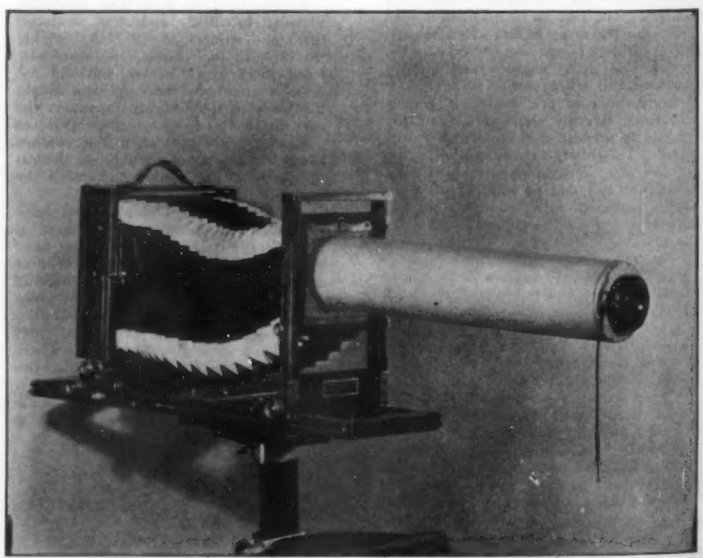
Homemade Enlarging Device

WHILE the ordinary view camera with a comparatively long bellows will produce photographs that are nearly life size, still there is often the desire to photograph minute objects so that the result will be several times larger than life size. The average bellows does not allow such work to be accomplished, so we must resort to a makeshift, after applying some of our knowledge of the science of photography to the problem.

The writer devised the arrangement shown in these columns when it was desired to photograph a scorpion larger than life size. Two of the resulting pictures are reproduced here. They were taken by fastening a heavy mailing tube to the lens-board of the camera and placing the lens in the open end of the tube. It is obvious that all of the joints must be perfectly light tight and that a suitable source of illumination must be provided, if daylight is not available.

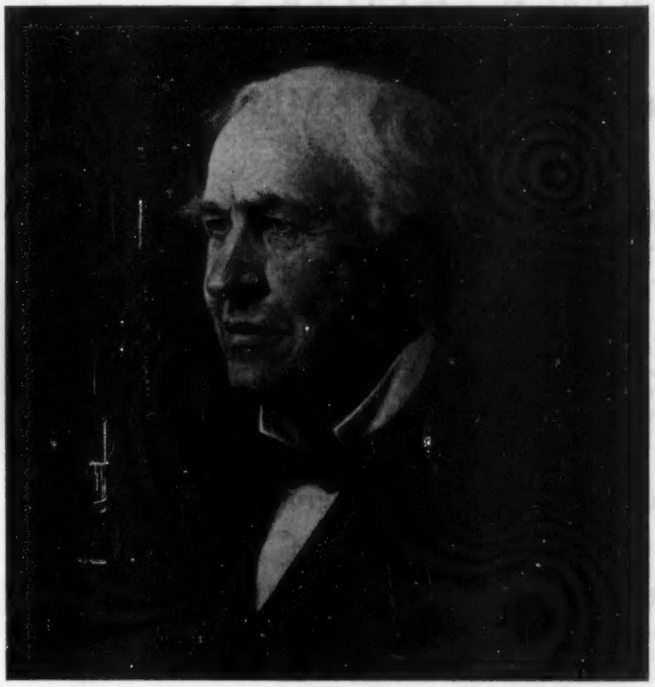
After the tube has been placed and the other arrangements made, the focusing is accomplished in the usual way by racking the lens-board back and forth. When photographing inanimate objects, a great depth

(*Continued on page 74*)



The mailing tube in place with the lens in the end of it

A *Regular* Reader



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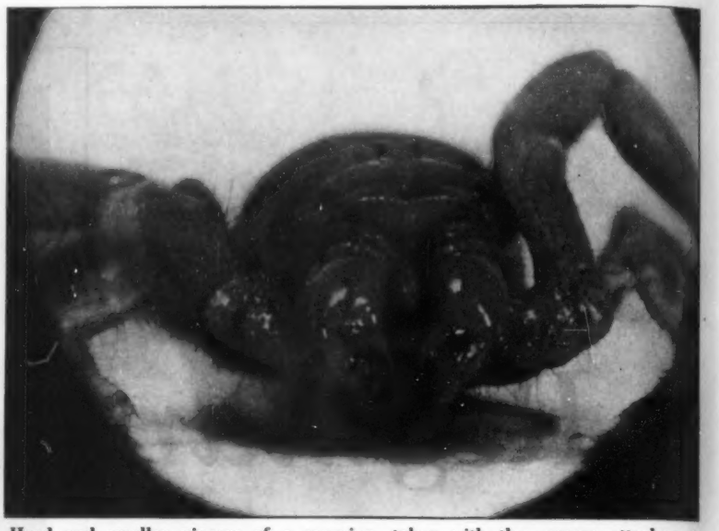


Head and smaller pincers of a scorpion, taken with the camera attachment described and illustrated on page 72

of focus can be obtained by the use of a small aperture and a long exposure.

Contributed by LLOYD COOPER.

Effortless Silver Cleaning

THE old way of cleaning silver is by the use of an abrasive paste, powder, or cake polish. The new way, says Roger S. Estey, M.Sc., Assistant in Physics at Washington Square College, New York University, is to place the silverware in an aluminum pan containing a hot solution of baking soda, salt, and water. One teaspoonful of each ingredient in a quart of water is satisfactory. An electrolytic action takes place between the silver, aluminum, and the solution and separates the tarnish from the silver, leaving the latter clean without any effort on the part of the user.

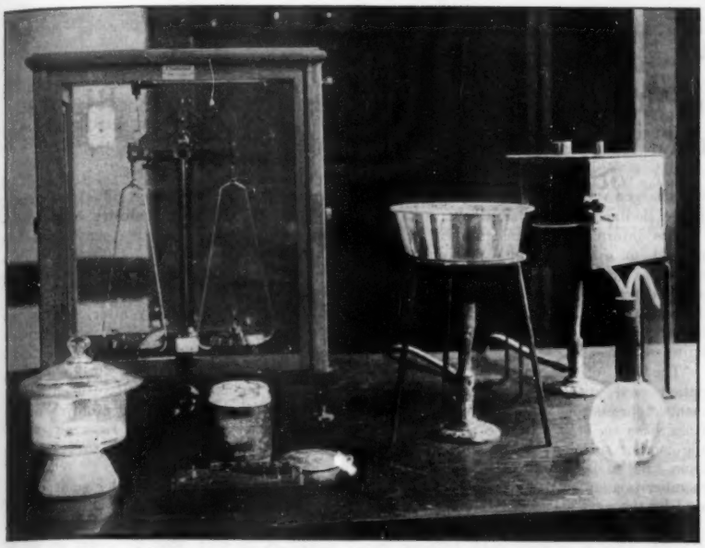
Situations of two types have arisen in the introduction of this scientific method into the home. Many people cling tenaciously to old methods, fearing the new, little understood method may damage their silverware. In the second situation people unwittingly pay exorbitant prices for magic plates which to the casual observer appear to be aluminum, and, whatever their material, merely serve the same purpose as the aluminum pan mentioned above. I have seen plates of this type about four inches square sold for a dollar.

Ordinary silver polish contains chalk, rouge, soap, a preservative, and sometimes ammonium chlorite. The cleaning action is almost entirely mechanical. The chalk or rouge which is applied abrades the surface, and removes the stain, which is usually a compound of silver with sulfur from the coal gas and smoke in the air, or from the sulfur compounds of eggs, salad dressing, mustard, and other foods. Although this silver sulfide is fairly soft and is easily removed from the hard metallic silver beneath, yet because the tarnish eats into the surface of the metal, the removal of the last vestiges of it removes considerable silver at the same time. Furthermore, in order to prepare a polish which will work fairly rapidly and without too much scrubbing, a rather coarse grade of rouge or chalk is used. This leaves minute scratches on the silver and soon dulls the brilliant polish which it originally had.

The scientific method of cleaning silver works in quite a different manner. The soda solution attacks and loosens the bonds of the sulfur atoms linked with the silver atoms in the tarnish. The aluminum is the agent which completes their separation. The aluminum and silver in a solution of this sort form a wet cell or electric battery of a very weak kind. When the two metals come in contact, the circuit is closed and the resulting current carries the sulfur atoms, which are by nature negatively charged in a solution of this sort, from the silver, which is negative, to the aluminum, which is positive. This is in accordance with the law that like electric charges mutually repel and unlike charges attract. Thus by this method the aluminum is tarnished and the silver is cleaned. Of course, the tarnish on the aluminum can be easily wiped off if cared for promptly.

Tests were made in order to determine the effect of each kind of cleaning. A silver spoon (Rogers Brothers, 25-year plate) was cut in two. As the result of a heavy coat of tarnish one piece gained 1/19,000

Tail and sting of scorpion, also taken with camera described



The apparatus which was used by Mr. Estes in the experiments conducted to determine whether polishing injures silverware

part of its weight. This tarnish was carefully scrubbed off with a good grade of silver polish. A second weighing showed this piece to be lighter by 1/1,300 of its original weight. That is, all the tarnish had been removed, *and considerable silver besides.*

The other piece of the spoon was tarnished with a heavier coat, constituting 1/7,000 of the whole. This piece was placed in an aluminum pan containing a boiling solution of Gold Dust, one teaspoonful to a pint of water, as this material contains, among other things, washing soda and one-fourth of one percent of common salt. In three minutes this piece of silverware was perfectly clean. (It bore a slight yellow scum due to the boiling, but this rubbed off quite easily.) The loss of weight in this case was inconsequential—only 1/13,000 of the original. Boiling a spoon for 45 minutes in this solution caused no appreciable change in weight, showing that after the tarnish was dissolved, all action on the silverware ceased.

Gold Dust was used in the test because, since the manufacturer claims it will clean silver in this manner, it would be most convenient to wash both dishes and silver together in an aluminum dishpan. That is, while the soap part of the Gold Dust was cleaning the dishes, the soda and salt part would be polishing the silver. Originally, however, the tests were prompted by the desire to see whether a prolonged immersion in a hot Gold Dust solution would do silverware any harm.

It is interesting to note that in polishing off a certain amount of tarnish, ten times as much silver as tarnish was rubbed away, while tarnish removed scientifically took only half its weight in silver with it. Hence, while good silver will undoubtedly last a long time in any event, it will last twenty times longer if cleaned with salt and either washing or baking soda in an aluminum pan.

A summary of the weights is as follows:

	Cleaned with Polish	*Cleaned in Aluminum Pan*
Original weight	11.2166	15.8967
After tarnishing ...	11.2172	15.8989
Weight of tarnish..	.0006	.0022
After cleaning	11.2082	15.8955
Silver removed	.0084	.0012
Weight after 45 minutes of boiling...		15.8945

All weights are in grams.

Dimming Switch

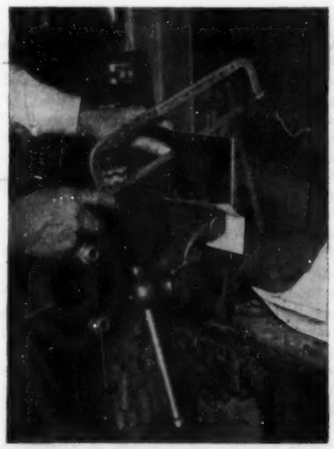
IN many types of automobiles the headlight dimming switch is rather out of the way. In such a case, it is a simple matter to install a small single-pole, double-throw toggle switch in the side of the car, convenient to the left hand of the driver, and wire it in the headlight circuit so that it will take the place of, or supplement the working of the standard switch, as desired.

How to Cut Hard Rubber

HARD rubber is an excellent insulating material and as such, it finds many uses in the experimenter's shop. Some workers find trouble in cutting this material, but if they will follow the accompanying illustration and the next few sentences, they will receive help.

Hard rubber should always be clamped firmly when being cut. For this purpose it is advisable to place it in a vise as shown. The surfaces of the insulating panel should be protected from mechanical damage due to the pressure of the vise jaws by means of two strips of thin wood, placed one on each side of the panel and between it and the vise jaws. Then the hard rubber can be cut with a fine-toothed hack saw, following a scribed line. The cutting should be performed slowly and carefully and no effort should be made to force the work. A very slight pressure on the saw is all that is required. If the pressure is too heavy, there is a chance of breaking the panel. This is especially true of the thinner stock used in some electrical work. While the saw is cutting through the panel, brace the latter with the free hand so that it will not be strained unduly.

If care is used in this work, the surface adjacent to the cut edges will be smooth and free from breaks. If too much pressure has been applied, the edges will be chipped and it will be necessary to dress them up with a fairly fine file.



When cutting hard rubber, it should be clamped firmly, taking care to protect the surface from injury. A hack saw is used, and the panel steadied with the hand

1864 1927

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

THE prospects for success of an inventor depend not alone upon the degree of ingenuity he has employed nor even upon the amount of business ability that he uses to market his new ideas. One of the biggest factors in determining whether he will be successful or not is the public demand which exists or which may be created for what he has to offer. As civilization progresses, many devices are going out of use. Electric washing machines, for example, are replacing the old method of having the housewife bend over the washboard and rub her knuckles to the bone. An inventor who patented a new type of hand washboard would find less and less demand each year. *Don't expect to profit with an invention in a losing game.*

Canadian Patent Progress

THE annual report of the Canadian Patent Office shows that in the fiscal year 11,001 patents have been issued. This is 1,493 more than last year and represents a gain of nearly 16 percent. The number of applications was 11,133. This was 3,701 fewer than last year or a decrease of over 25 percent, but is above the average for the last ten years. Applications allowed by examiners totalled 11,818, a decrease of 240, or about 2 percent.

Copyright registrations numbered 2,861, or 66 more than the preceding year and the greatest in any year. Registrations of trademarks were 2,601, a decrease of 141, or over 6 percent. Industrial designs granted totalled 494, an increase of 38. The total transactions relating to copyrights, trademarks, designs and timber marks were 7,345. This is 774, or nearly 10 percent less than the previous 12 months.

Of the patentees, 1,292, or nearly 12 percent reside in Canada, a decrease of 1 percent. The United States is the home of 7,891, or over 71 percent of the total, a gain of 2 percent. Residents of Great Britain and the British colonies applied for 933, or over 8 percent, a decrease of 1 percent.

What Price Infringement

IF you infringe the trademark of another you are liable to the surrender of all the profits you made by so doing. Such surrender is required of the M. H. S. Paint Manufacturing Company, sued in the Minnesota United States District Court by the Minnesota Linseed Oil Paint Company. The M. H. S. Company also is perpetually enjoined from using the plaintiff's trademark "Minnesota." Judge Molyneaux holds:

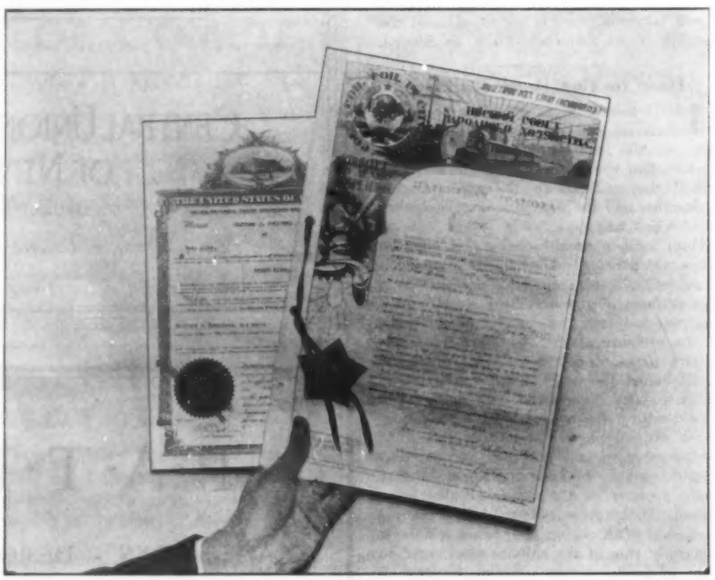
"This court ought to and does grant an injunction perpetually enjoining the defendant, the M. H. S. Paint Manufacturing Company, its officers, agents, employees and privies, from competing unfairly with plaintiff in any manner whatsoever, and from representing in any manner whatsoever that the goods of defendant are in fact the goods of plaintiff; and that an accounting be had under the direction of this court, requiring the defendant, the M. H. S. Paint Manufacturing Company, to account for and pay over to plaintiff all profits that have been received by the defendant from all sources in the business obtained and done by it by reason of defendant's unlawful and wrongful use of plaintiff's trademark, and by reason of defendant's infringement upon plaintiff's registered trademark, and by reason of the aforesaid acts and doings of the defendant in violation of plaintiff's rights, together with all of plaintiff's damages suffered by reason of said acts of defendant, and any increase thereof as directed by this court under the statute because of defendant's wanton and deliberate violation of the plaintiff's rights in the premises, and that plaintiff recover the costs and disbursements of this action."

We Offer Our Services

FROM time to time inventors and patentees write to the Scientific American asking to be put in touch with manufacturers looking for inventions. Likewise, manufacturers from time to time ask us to inform them of inventions suited to their facilities and their market. It is a pleasure for us to bring manufacturers and inventors together where the meeting will be to their mutual advantage.

In those cases we have been of service because one of the parties asked us to. Doubtless, there have been other cases where we could have brought inventor and manufacturer together, had either of them requested us to do so. The fault is ours; we should have extended an invitation.

We have now started two files, one listing manufacturers who desire inventions, along specific lines, and one listing inventions whose inventors are seeking manufacturers. Any reader of the Scientific American may record an invention or a need for an invention. Where a listed invention meets a listed need we shall notify both parties. There will, of course, be no charge for this service.



A Bolshevik patent is here compared with a United States patent. In addition to being a bigger document, the Russian patent states that unless the invention is worked within five years, the patent becomes void. Russian patents run for fifteen years—United States patents for seventeen years

Ball Games in Conflict

PERHAPS few of the thousands of baseball fans who stood in the streets last summer watching the ingenious boards in front of newspaper offices realistically record the play-by-play progress of the home team, realized that they were watching a device about which an interesting patent infringement suit was at that very moment being fought out in the Federal Court in New Jersey.

Two patents controlled by the Star Ball Player Company were involved; the first has 34 claims and the second 40. The defendant, the Playograph Company, however, was charged with infringing only four claims. Judge Bodine in his opinion says:

"The information is telegraphed or telephoned to operators, who manipulate the device as the game progresses. The principal defense is non-infringement, and it seems obvious that this has been well established. The patents are in a very crowded art.

"The gist of the invention in the first patent sued upon is that the movable elements representing the runner are relayed from base to base. In the second patent, the runner members are adapted to relay from base to base while the bodily relayed member is adapted to be picked up and carried by the next succeeding runner member.

"In the plaintiff's board, there are four separate moving devices, each between two bases and the indicator is relayed from base to base; while in the defendant's board there is only one carrier which continues in its movement around the circuit of the bases and the player indicators are manually applied."

What Is Patent Infringement?

"STRICTLY speaking, infringement of a patent is an erroneous phrase," quotes Judge Inch, dismissing the complaint brought by the Radio Corporation of America *et al* against the Twentieth Century Radio Corporation. "What is infringed is the claim which is the definition of invention and it is the claim which is the cause of action."

Aside from the direct parties to the issue, the contest really was between the plaintiffs and the Garod Corporation associated with the Hazeltine group of radio manufacturers. The court calls attention to the fact that up to 1923 the so-called "Armstrong" regenerative sets dominated the market. The "squeals," however, were disturbing in a neighborhood having other receiving sets. Hazeltine was consulted by those commercially interested.

"Whether or not Hazeltine did succeed in entirely avoiding infringement of Armstrong is not before us," says the court. "That he gave to the commercial world a new receiving set seems to be without question. Immediately the 'crystal set' practically disappeared. There has arisen almost overnight a great and important industry in the making and selling of receiving sets, a substantial portion of which (50,000,000 dollars worth), were and had been employing Hazeltine's idea.

"At this time and only after this success by dealing in these radio sets, the plaintiffs come and claim that this defendant's 'apparatus' and 'circuit' infringes certain patents, which so far as I can see, have been quietly resting, with others, in the archives of the various efficient and large research departments of these enormous and useful corporations.

"It would seem to me under such circumstances and in dealing with an industry of such importance, and usefulness, and practically at its start, that the court should be cautious in deciding this difficult and highly technical matter and, unless it can, with reasonable assurance, point to plain reasons justifying its decision, should refrain from possibly destroying a part of a large and useful business and denying inventors, in what would seem to be a large enough field for all, their respective rightful monopolies."

Aggregation Is Not Invention

COMBINING a number of old elements that have never been combined before is not necessarily invention. There must be a new result before you are entitled to a patent. This is made clear in the case of the Sodemann Heat and Power Company against Samuel Kauffman in the Eighth Circuit Court of Appeals.

Kauffman's patent was for a radiator shield. A lower court had held that his shield was a combination of old mechanical elements which did not rise to the dignity of a patentable invention, but was a mere aggregation. The higher court, however, holds,

"While the evidence justifies a finding that patentee's device is a combination of old elements, it also justifies a finding that a new result is produced by his device, which is more efficient than any heretofore known, to deflect, by the use of the shield in his device, the dust particles arising with the heat from the radiator into a trough, where they will be retained, and protect the walls and ceilings from the black dust and smoke arising from the radiator.

"Nor are we satisfied that there was any error in the finding of the court below that the defendant had infringed upon the patent of the plaintiff. Our conclusion is that the plaintiff Kauffman invented a new combination of old mechanical elements whereby a new result was obtained in a more useful, easy, economical and efficacious way than it had ever been obtained before and that the decree in his favor ought to be affirmed."

Air Furnace Remains "Victor"

ALTHOUGH it is a general principle of trademark law that you may extend the use of your mark to cover articles which you might make later in the logical development of your business, still there may be exceptions to this rule. The decision of Assistant Patent Commissioner Moore in refusing the Victor Stove Company the right to register "Victor" as a mark for furnaces illustrates an exception. The registration was opposed by the Hall-Neal Company, which manufactures the Victor hot-air furnace.

"It appears from the evidence," the Assistant Commissioner holds, "that for a long period of years the two companies sold their respective goods in substantially the same territory, each using the word 'Victor' as its

trademark, without a single instance of confusion in the public mind as to the authorship or ownership of the respective goods. While heating stoves and hot-air furnaces belong to the same general class of merchandise and may in some cases, have the same descriptive properties, yet the above evidence as to fact overcomes the theory advanced by the petitioner that its heating stoves are of the same descriptive properties as the registrant's hot-air furnaces."

A Boomerang Patent Case

NOT only have Bertha Powell and the Americolite Company failed to get an injunction in their infringement suit against the Planelight Company, but Judge A. W. Hand in the United States Southern New York District Court has warned them to cease annoying the defendant.

"The patents in suit," explains Judge Hand, "relate to electric-light fixtures of the so-called semi-indirect type combining a reflecting ceiling plaque and a depending reflector so that the light is both transmitted through the depending reflector and reflected by it upon the ceiling plaque and in turn reflected therefrom by the indirect light."

After comparing the patents at issue with each other and with other preceding patents, he holds:

"In view of the foregoing, I have great doubt whether the patent is not void for lack of invention, but at any rate I think it is not entitled to sufficient scope to cover defendant's device. A preliminary injunction cannot be granted.

"The complainant has done practically no business and has apparently been trying to bolster up a weak case by threats and intimidation of defendant and its customers. I am quite satisfied that if they continue, an injunction should be granted to the defendant, but it will probably be enough to give this warning and retain jurisdiction of defendant's motion so as to grant relief if further annoyance occurs."

The Court Reaches Over the Border

CAN a manufacturer in the United States get from an American judge an injunction restraining another from infringing a trademark in Canada? The answer is unmistakable in the case brought by the Societe Enfants Gombault Cie against Lawrence-Williams Company in the United States Court for the Southern District of Ohio. Both firms were calling their products "Caustic Balsam." Says Judge Westenhaver:

"No reason is perceived why the territory of Canada should be excluded from the injunction. No different situation with respect to plaintiff's and defendant's trade in that territory is perceived from what it is in the United States. Certainly, the fact that defendant had plaintiff's product shipped to defendant direct from France to Canada, instead of having it first shipped to the United States and then reshipped by defendant to Canada, is not a material difference. This court has jurisdiction of the parties and may, therefore, pass a decree binding upon them everywhere.

"Defendant has the right to use the term 'Caustic Balsam' as a generic and descriptive term. As stated in my former opinion, what it may not do is to market and sell the same as and for plaintiff's product."

Sound Law for Acoustics

TWO principles of patent law, well established but not generally understood by the layman, are illustrated by the important case of the Lektophone Corporation versus Western Electric Company in the District Court for the Southern District of New York. Judge Thatcher, in holding that the plaintiff's acoustic device, patented by Marcus Hopkins in 1918, is valid but not infringed, makes it clear that a patent may be valid even though the invention involves old principles, and further, that a patent is no broader than its claims.

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

PROPELLER FOR FLYING MACHINES.—So constructed that it will cause an immediate vertical lift, and will exert a direct control upon the descent of the aeroplane it has lifted. Patent 1602778. J. W. Pitts, c/o W. R. Banks, Y. M. C. A., Detroit, Mich.

Pertaining to Apparel

GLOVE.—Constructed to allow perfect freedom of the fingers to securely grip an object, yet securely maintain the glove against accidental displacement. Patent 1601143. S. A. L. Olson, 941 So. Figueroa St., Los Angeles, Calif.

NECKTIE AND METHOD OF MAKING THE SAME.—In which the lining and facings are connected throughout their edges with whipped stitching to prevent breaking by longitudinal stresses. Patent 1604091. I. D. Wolfson, 15 W. 39th St., New York, N. Y.

ABDOMINAL SUPPORT.—Which may be applied while in a reclining position, when the abdomen assumes its more normal condition, thus eliminating the exerting of strap pressures. Patent 1604076. J. M. Risselt, 14 Oak St., Tenafly, N. J.

BELT HOOK FOR UNIFORM GARMENTS.—Having a detachable means for associating the hook with the garment, so that the same may be removed during washing and pressing of the garment. Patent 1604067. G. S. Norris, 1024 Boston Road, New York, N. Y.

NECKTIE.—In which the bow portion is secured intermediate its ends across and at right angles to a neckband portion of the same. Patent 1604092. I. D. Wolfson, 15 W. 39th St., New York, N. Y.

Electrical Devices

X-RAY READING LAMP.—For facilitating the reading of x-ray pictures, by casting light rays therethrough, and means to focus the light in accordance with the picture. Patent 1602347. A. Eustace, 30 Murray St., Flushing, N. Y.

DEVICE FOR APPLYING AND REMOVING BATTERY CONNECTERS.—Adapted to be clamped on a terminal of a battery, to cause a pair of jaws to force the connection from the terminal. Patent 1601752. J. G. Wortham, 112 No. Jackson St., Tullahoma, Tenn.

TUBE BASE.—For a radio tube, having contacts of such arrangement that the electrical conductor can be clamped directly thereto. Patent 1602056. P. M. Tebbs, 1617 Forster St., Harrisburg, Pa.

ELECTRIC WINDOW CLEANER.—Which may be readily manipulated from the inside of a room, to simultaneously clean both inner and outer face of the window pane. Patent 1603175. D. Weisz, 206 E. 9th St., New York, N. Y.

ELECTRIC CONTROL FOR TAXIMETERS.—Whereby the meter will register as soon as a passenger is seated, even though the controlling flag is not turned down by the chauffeur. Patent 1604042. O. Handler, 1699 Washington Ave., Bronx, N. Y.

ARRANGEMENT FOR ROASTING, GRINDING, AND COOKING COFFEE OR THE LIKE.—An electrically heated apparatus, comprising a chamber for the green beans, a roasting device, a grinding device, and a receptacle for collecting ground beans. Patent 1604058. H. Mager, c/o A. Urhantschitsch, I Tuchlauben 21, Vienna Wien, Austria.

ELECTRICAL CONTACT MOUNTING.—A universally movable mounting through the functioning of which adjacent plane contact surfaces may establish complete engagement. Patent 1604154. J. E. Erskine, Box 111, R. 2, 21st and Talleyrand Ave., Jacksonville, Fla.

CONDENSER-OPERATING DEVICE.—Whereby a plurality of condensers can be operated simultaneously and with accuracy in regard to their simultaneous relative disposition. Patent 1604171. C. B. Kinley, 33 Elmhurst Ave., Detroit, Mich.

ELECTRIC LAWN MOWER.—In which the power for operating the blades, is derived from the ordinary house lighting current by a suitable conductor. Patent 1603637. C. W. Ott, 309 Commerce Bldg., Pittsburg, Kansas.

RADIO VACUUM TUBE SOCKET.—Which will afford means of electrically supporting within a socket a tube, selectively in either contact or break positions of terminals. Patent 1603121. C. R. Krone, 410 28th St., Oakland, Calif.

ELECTRIC-LAMP-SOCKET ATTACHMENT.—Whereby the lamp socket and lamp may be readily combined with a vase, to produce a reading lamp, without drilling or cutting the vase. Patent 1605778. W. A. Riley, 2 Manhattan Ave., New York, N. Y.

Of Interest to Farmers

BROODER.—Made up of any desired number of cooperative sections so that the capacity may be increased or decreased at will. Patent 1603113. J. Jenkins, R. R. No. 1, Hillsdale, Ind.

GATE LATCH AND SUPPORT.—Which may be set to cooperate with the gate to secure the same, irrespective of the direction in which the gate swings. Patent 1603176. M. Whiteford, R. D. No. 1, Manito, Ill.

STOCK GUARD.—To be positioned across an irrigation ditch, gateway or opening, to prevent the passage of stock, but adapted to provide a smooth surface for the passage of vehicles. Patent 1603846. F. A. Garcia, R. F. D. No. 2, Box 168 B, Pueblo, Col.

PLANTER.—Which automatically measures the quantity of seed to be planted at predetermined intervals and releases and deposits the seed in the ground periodically. Patent 1604624. T. White, Pleasant View Farm, Marion, Mich.

HAY BUNCHER.—Capable of picking hay from the ground, lifting it, and throwing it back in inverted position that it may cure more uniformly. Patent 1603190. W. R. Butner, P. O. Box 108, Yerington, Nevada.

EGG-IDENTIFYING DEVICE.—Whereby eggs laid by any one of a number of hens can be readily identified and the laying proclivities determined. Patent 1604399. R. P. Estrada, 422 Sierra St., Los Angeles, Calif.

Of General Interest

GATE OPENING DEVICE.—Readily applied to a gate, and operable at a predetermined point from the closure, for unlocking or locking the same. Patent 1599728. W. C. Strong, c/o Pellans, Cowley & Gresham, Van Antwerp Bldg., Mobile, Ala.

DISPAY STAND.—Including a tray and a transparent dome covering the tray, primarily intended for displaying candy or the like. Patent 1600132. J. S. Pearl, 19 Spring Garden Road, Halifax, N. S., Canada.

CALENDAR.—In the form of a perpetual calendar, which has a wide range over the centuries, and may be easily adjusted for any particular period. Patent 1600874. J. Greenwood and J. E. Sparks, 908 Keystone Bldg., Houston, Texas.

NEEDLE.—Especially useful in sewing burlap or mending torn feed sacks. The needle is so formed that it may be used as an advertising novelty. Patent 1600884. R. C. Jones, Jefferson, N. Y.

INNER SEAL FOR CASKETS.—A simple and reliable means for firmly and securely mounting the glass panel on the metal frame of the inner seal. Patent 1600768. E. Lunsford, 402 Oak St., Atlanta, Ga.

ANCHOR FOR GUY LINES.—Easily placed in position, yet will not creep even when subjected over a long period of time to heavy strains. Patent 1601682. H. L. Curd, 728 No. 10th St., Waco, Texas.

MEANS FOR COOLING REFRIGERATORS.—By means of which it is unnecessary to em-

"There is not to be found in the prior art a sounding board such as Hopkins designed and had patented as his invention," he says, "and it is not enough to defeat his patent to say that the elements of his claims are already found in the prior art in isolation or in other combinations. His was a combination and arrangement of old elements capable of better results than the old devices."

As to whether the Western Electric Company's acoustic device infringed, he says:

"A patent broader than its claims is a legal absurdity, and in this case involving a mechanical combination, the limitations incorporated in the stated claims cannot be ignored or construed contrary to the plain import of their terms. That the defendant's structure is unlike the patented structure, not only in its form of construction, but in its mode of operation, was clearly demonstrated by the tests to which reference has been made."

Japanese Seek Recognition

REPORTS from Tokio state that the Japanese Imperial Academy is planning to issue periodicals in foreign languages about the achievements of their inventors and research workers in science. These pamphlets will be distributed among foreign academies and universities.

Japanese scholars believe that Japanese inventors and scientists have been deprived of rightful honors in foreign countries because of a lack of suitable organs of publication. For example, Dr. H. Nagaoka was deprived of the honor of the first experiments to extract gold from quicksilver, they say, and Dr. W. Suzuki is not recognized abroad as discovering vitamines a year before a foreigner did. Such cases, they declare, are increasing, and the Academy's proposed periodicals are calculated to put an end to them. In addition, the Academy will begin registration of inventions and new theories by Japanese.

What the Patent Office Needs

THE Special Patent Office Committee which has been studying the needs of the Bureau since July, 1924, makes 108 separate recommendations to Secretary Hoover. The five leading features are:

1. Modern equipment, including vertical steel filing cases.
2. A new building.
3. Many more technical workers, including a larger number of principal and assistant examiners and a larger translating and classification force.
4. Higher salaries.
5. An amendment of the statutes governing practice in the Patent Office, reducing the appeals in interference cases to a single appeal in the office, abolishing appeals to the Court of Appeals of the District of Columbia, and making the decision of the Patent Office final, except as it may be reviewed by the United States District Court in equity proceedings.

Chemists Seek Protection

DISCUSSION at the meeting in Washington of the International Union of Pure and Applied Chemistry has brought out the fact that many European chemists have been deprived of large earnings through the lack of laws to protect discoveries which have been appropriated by manufacturing corporations. The Union has sponsored a plan for presentation to foreign governments proposing the adoption of the provision of the American Patent Law which allows an applicant for a patent priority for a period of two years following publication of a formula made accessible to the public. Foreign patent laws now contain no such safeguard.

A special committee will forward the proposal to the constituent bodies of the International Union throughout the world, and the replies obtained will be submitted in the form of a report with recommendations to the annual conference of the Union in 1927 to be held in Poland.

ploy other artificial cooling mediums, in a refrigerator during the cool months of the year. Patent 1600522. G. A. Strehlke, Des Plaines Hotel, Des Plaines, Ill.

COFFEE PERCOLATOR.—Which is adapted for varying the quantity of beverage to that which is less than the full capacity of the percolator. Patent 1601403. F. A. McGuire, c/o St. Francis Xavier Church, Cherryville, Kans.

BOOKREST.—For holding a book in any one of a wide variety of inclined positions, the pages being retained by adjustable pegs. Patent 1601463. T. S. White and W. B. Vinson, 529 Merrick St., Shreveport, La.

CONCRETE MOLD.—Which is simple and collapsible, formed of reusable sections, for use in the construction of reinforced joists and floors. Patent 1601389. O. L. Gent, 344 So. Gillette St., Tulsa, Okla.

PASTEURIZING APPARATUS.—Providing a more effective and quicker application of heat or cold to the liquid being treated, easily kept in a sanitary condition. Patent 1599730. J. Teiles, c/o California Tin Plating Works, 1705 Mission St., San Francisco, Calif.

CLEANING COMPOSITION.—Containing kerosene, oleic acid, aqueous ammonia, and water, for cleaning the hands of grease, paint, ink, etc., without injurious effect on the skin. Patent 1598664. J. Le V. Teach, 546 E. Stephenson St., Freeport, Ill.

GRAVE CANDLE.—Which will not be easily blown out by a draft of air, nor extinguished by rain, for use also in a place of worship. Patent 1601677. A. Cesareo, 1118 Flatbush Ave., Brooklyn, N. Y.

BUCKET SUPPORT.—For supporting a pail or paint pot, from a ladder, maintaining a horizontal position to prevent spilling the contents. Patent 1601652. F. Sohnle, 63 Fairview Ave., Newark, N. J.

BUILDING CONSTRUCTION.—To be incorporated in a wall or ceiling as a unit, sheet metal elements functioning as studding and braces. Patent 1601630. L. L. Lesoine and F. C. Emmel, c/o F. C. Emmel, 162-04 78th Ave., Flushing, L. I., N. Y.

CLIP FOR LOOSE-LEAF BINDERS.—For connecting the leaves with the binder back, and permitting its removal therefrom and association with another back. Patent 1601629. W. Lean, 251 Clifton Place, Brooklyn, N. Y.

FRUIT PRESERVING AND SHIPPING PACKAGE.—A folding paper carton, or box with means arranged interiorly for maintaining the contents substantially in original condition. Patent 1601625. T. J. Hruby, c/o C. D. Ordway, Vermont Spool & Bobbin Co., Burlington, Vt.

TEASPOON.—Adapted to serve as a container for tea leaves, as well as its usual function as a stirrer. Patent 1601613. J. Fenyves, 112 E. 98th St., New York, N. Y.

PONTOON BRIDGE.—The pontoons being so associated as to permit the movement thereover of excessive loads, such as cars and locomotives. Patent 1600548. J. H. Johnson, P. O. Box 48, Memphis, Tenn.

PURSE.—Having two pockets, one revolving within the other, both being provided with peripheral openings, and requiring no snaps or metallic portions. Patent 1600633. P. Hildebrand, Box 180, San Francisco, Calif.

STEEL POST AND BASE FOR MAIL BOXES.—A combined post and base of knock down form, which will permit of a mail box being firmly seated and fastened thereon. Patent 1602290. C. E. Taylor, c/o A. B. Taylor, R. F. D. No. 8, Spokane, Wash.

DISPLAY CARD.—Formed from a single blank of material and folded to act as a support for the display of articles, such as bottles, containers, etc. Patent 1602348. F. E. Everson, 16 Barry Place, Scarsdale, N. Y.

DESIGN COMPOSING AND REPRODUCING DEVICE.—By means of blocks which may be conveniently arranged for the design or pattern to be created, and may be repeatedly used. Patent 1602356. C. Franz, 97-12-190th St., Hollis, L. I., N. Y.

CARBOY HOLDER.—In which carboy breaking is reduced to a minimum, but should it break the liquid will be prevented from flowing out of the holder. Patent 1602326. W. G. Bjorkstedt and P. A. Rosan, 42 Hammond St., Jamaica, L. I., N. Y.

TOOTHBRUSH.—Having relatively soft bristles, and a handle attachable in various positions giving a movement parallel with the crevices of the teeth. Patent 1600975. J. M. Calkins, P. O. Box 611, Detroit, Mich.

GLASS JAR.—Adapted to be used with either a metal threaded cap or a flanged glass cap and holding clamp. Patent 1602,346. N. D. Eller, c/o A. M. Campbell, c/o Glamorgan Pipe & Foundry Co., Lynchburg, Va.

VANITY CASE.—Having a plurality of shallow superposed open containers each adapted to hold cosmetics or other small toilet articles. Patent 1601991. S. Albert, 115 Lenox Ave., New York, N. Y.

SYSTEM OF TAKING PHOTOGRAPHIC AND CINEMATOGRAPHIC PICTURES.—By which objects of different scale are united within the camera by means of a mirror to the scale and conditions required. Patent 1601,886. E. Schufftan, Berlin-Wilmersdorf, Germany.

APPARATUS FOR PRINTING PHOTOGRAPHS FROM NEGATIVES.—In which the intensity of the light may be accurately varied, according to the density of the negative, by the operation of the platen. Patent 1602051. I. D. Sharp, c/o Sharp & Co., Nicholasville, Ky.

AUTOMATIC GAS CUT-OFF DEVICE.—Which operates upon any reduction in pressure in a main, to discontinue the flow, and thus prevent subsequent leakage from unlighted burners. Patent 1601276. F. Webb, Box 502, Torrance, Calif.

SEPARATOR.—For separating the lighter liquids from the heavier, in mixtures comprising liquids of different specific gravities, without any appreciable agitation. Patent 1602354. C. Fowler, Hiddenstead, Andover, Mass.

PRECIOUS-METAL RECLAIMER.—For recovering finely divided precious metals from wash basins in the manufacturers of precious metal arts, dental waste waters, and the like. Patent 1602343. H. O. Duerr and F. N. Brown, 407 Mills Bldg., El Paso, Texas.

FILTER.—So constructed that it may be readily taken apart and cleaned, the scrapers for the filter stone being detachable. Patent 1603126. T. Linke, 220 W. 46th St., New York, N. Y.

CLOSET.—Constructed with semi-circular revolving shelves so that articles thereon may be readily accessible, yet having no waste space. Patent 1603127. G. Lombardo, 31 Troutmon St., Brooklyn, N. Y.

SHIP'S LOG.—Constructed to be mounted at any suitable place, and to accurately indicate the ship's speed when moving evenly, or listing. Patent 1603161. R. Star, 84 Flushing Ave., Brooklyn, N. Y.

EDUCATIONAL APPLIANCE.—For facilitating the teaching of primary pupils, by associating the name of an object with a pictorial representation of the object itself. Patent 1603201. J. H. Frome, Rushland, Pa.

PERCOLATOR URN.—With which a coffee beverage may be made in different measured quantities to meet the particular demands of restaurants, lunch-rooms, etc. Patent 1603130. B. H. McDuffie, c/o F. Waldhauer, 1721 Nostrand Ave., Brooklyn, N. Y.

MANUFACTURE OF EMULSIFYING INGREDIENTS OR MATERIALS AND EMULSIONS THEREOF.—Which comprises stirring fresh oil into an oil soluble colloid at a temperature of substantially 120°, then slowly and vigorously stirring water into the blend. Patent 1603155. E. V. Schou, c/o J. Preisz, Axelborg, Copenhagen, Denmark.

CONDIMENT HOLDER.—In which both salt and pepper or any other two condiments can be separately contained in and dispensed from the same holder. Patent 1602745. H. E. Binkele, 901 No. Spring St., Los Angeles, Calif.

BREAD.—Containing a preservative which will prevent the crumbling, after baking, of bread containing a high percentage of bran, or other coarse ingredients. Patent 1603709. A. S. Oliver and J. M. Johnson, c/o Eastern State Hospital, Medical Lake, Wash.

FLEXIBLE-BRACELET BOX.—Comprising a box structure having at one edge an inwardly extending flange acting to support a stone out of contact with the border. Patent 1604013. A. Bausch, 79 Nassau St., New York, N. Y.

NECKTIE HOLDER.—Designed for smoothly and conveniently holding a relatively large number of ties in a suitcase, without danger of wrinkling the ties. Patent 1604090. I. D. Wolfson, 15 W. 39th St., New York, N. Y.

VENTILATED MILK CAN.—Having means for protecting the ventilating openings to prevent insects, rain, dust, or other foreign matter entering the can. Patent 1603665. H. C. Deane, c/o Dr. G. J. Field, 621 Judge Bldg., Salt Lake City, Utah.

ROPE STRAND.—Comprising a strand body and a cover, said body comprising hands of loosely twisted unspun fibers, and the covering spirally laid spun yarn. Patent 1604,075. F. Riesenberg, 10 Henry St., Tuckahoe, N. Y.

CABINET AND CARRIER.—Used for dispensing railroad, or similar tickets, wherein the carrier may be readily applied and removed from the front of the cabinet. Patent 1604,077. H. Ruscher, c/o Ticket Office Equip Co., Grand Central Terminal, New York, N. Y.

COLLAPSIBLE FORM FOR CONCRETE BLOCKS.—Which cause longitudinal grooves to be formed in the blocks, for the accommodation of metal strips which may be nailed to a backing. Patent 1602035. W. D. McLaughlin, 207 Virginia Ave., Modesto, Calif.

WASHBASIN.—Having means for preventing splashing even though the basin is rocked from side to side as in a railway car, or moving support. Patent 1603677. C. Francis, R. 474, Union Station, Winnipeg, Canada.

WELL-CEMENTING DEVICE.—For use with well casings, providing a valve which will insure the prevention of a further flow of cement at the proper time, and also effect the stalling of the pump to advise the operator that the cementation has been completed. The inventor has been granted two patents, 1603834 and 1603835. A. Boynton, c/o Frontier Oil Co., City National Bank Bldg., San Antonio, Texas.

GREETING CARD AND THE LIKE.—Upon which a verse or greeting is inscribed, and in which a likeness of some person mentioned in the inscription may be revealed. Patent 1603592. F. Glasner, The Waushara Argus, Wautoma, Wis.

CIGARETTE CASE.—Adapted to receive a package of cigarettes with a portion of the paper cover removed, the case being formed to cover the exposed ends. Patent 1604894. J. P. Finley, Box 213, Tallahassee, Fla.

COLLAPSIBLE TUBE.—For containing a compound in the form of tooth paste or the like, with means for effectually operating and controlling the discharge. Patent 1604,175. A. C. Ladd, 133 So. Oliver St., Los Angeles, Calif.

TYPEWRITER ATTACHMENT.—Whereby a ribbon may be firmly secured to a reel and wound thereon without any liability of soiling the fingers with ink. Patent 1602470. B. White, c/o The Billboard, Chicago, Ill.

PASTEBOARD BERRY BOX.—Formed from a single board, folded and the parts locked together, without the use of staples, or other securing devices. Patent 1602702. E. E. Pinkerton, c/o Pinkerton Folding Box Co., 414 Rush St., Chicago, Ill.

BATHROOM FIXTURE.—Permitting the soap and tooth paste receptacle, to be so secured. by a wooden block, to the wash bowl, that the fixture may resemble all metal. Patent 1604469. A. O. Nelson, 5502 Kamerling Ave., Austin, Chicago, Ill.

COLLAPSIBLE ASSORTING RACK.—For the distribution and assorting of mail, which after having received the mail may be collapsed and placed in the mail carrier's vehicle. Patent 1602771. L. J. Mitchell, Dinuba, Calif.

FURRING STRIP.—Which will dispense with the usual wooden strips and provide a wall of even thickness strengthened by an interlocked wire within the plaster. Patent 1603124. F. E. Lawrence and E. A. Green, 636 Maple St., Santa Rosa, Calif.

LOOSE LEAF BINDER.—Which can be used as a current binder and subsequently as a permanent binder, having means for securing the top against accidental displacement. Patent 1604262. F. H. Crump, 225 East 4th St., Los Angeles, Calif.

SCREENING DEVICE.—For interior ventilating openings, capable of being secured within an opening without nails, screws, or any like fastening device. Patent 1604470. A. A. Newnham, 464 Summit Ave., Pasadena, Calif.

STRAINER.—For all kinds of straining in the household, provided with means for preventing insects and dust from reaching the contents while in operation. Patent 1605,887. Anna Banks, 924 North 20th St., Omaha, Neb.

AWNING.—Comprising a frame, and a flexible shade member carried by the frame in adjustable spaced relation to the window. Patent 1605037. F. O. Keifer, c/o W. G. Davidson, Ardmore, Okla.

VENEER BRICK OR TILE.—Of such nature that it can be hung upon the exterior walls of a building, thereby producing a durable and fireproof veneer. Patent 1604968. W. P. Burris, Box 247, Erie, Ill.

COMBINED BREAD RECEPTACLE AND SLICING PLATFORM.—Adapted to hold a loaf of bread or the like, and guide movement providing for cutting slices from the loaf of uniform thickness. Patent 1605770. M. W. Potter, 1627 Belmont Ave., Seattle, Wash.

Hardware and Tools

LATHE-TOOL HOLDER.—Which will facilitate the holding of boring or turning tools, centering the drill, and steadying or centering the work. Patent 1602330. J. D. Bowen, Cherry St., Mt. Pleasant, Millville, N. J.

FASTENER FOR SWINGINGLY-MOUNTED STORM WINDOWS OR OTHER SIMILAR CLOSURES.—Which can be adjusted quickly in any position between fully open and closed, from the inner side of the window or closure. Patent 1603581. B. McI. Campbell, c/o Hanitch, Hartley and Johnson, 1st National Bank Bldg., Superior, Wis.

AWNING HEAD-ROD HOLDER AND BRACKET. Quickly and easily mounted or demounted, and readily adjusted to accommodate different widths of windows without the use of tools. Patent 1604072. J. E. Phillips, 260 Convent Ave., New York, N. Y.

WINDOW LATCH.—Which will cause the sash members to bind against sliding movement, and will prevent manipulation from the outside when the sash is partly open. Patent 1602151. A. T. Gibson, 427A Hawthorne Ave., Oakland, Calif.

DOOR-LOCKING ATTACHMENT.—Which will prevent the forcing out of a key, by manipulation from the outside of a door, and the inserting of an unauthorized key. Patent 1604933. T. J. Ryan, Box 641, Douglas, Arizona.

DEVICE FOR TENSIONING A TRAP.—Having the striking bar so constructed that the slipping lever automatically locks the striking bar when the bar is tensioned by hand. Patent 1604920. J. P. H. Kroon, c/o Nederlandsch Oetrooi-Bureau, 31 Luan Copes Van Cattenburch, Gravenhage, Holland.

Heating and Lighting

SILENCER FOR OIL BURNERS.—Especially that type wherein oil is mixed with air, the device is simple, and will not interfere with the action of the burner. Patent 1601751. E. C. Wills, 330 Grove St., Newark, N. J.

REFUSE AND GARBAGE INCINERATOR.—Which may be easily and quickly started, and after starting will be continuously automatic in its action, adapted for bulky trash. Patent 1603589. A. C. Felton, Jr., c/o Nye Odorless Crematory Co., Macon, Ga.

RESERVE HOPPER FOR ACETYLENE-GAS GENERATORS.—Adapted to hold a sufficient quantity of acetylene to assure continued operation after the main supply container has been exhausted. Patent 1603887. F. A. and P. E. Webb, Box 352, Arkansas City, Kansas.

HEATING ELEMENT.—Which will quickly take up the heat units and give off the heat units, and is especially adapted for use with a prehenter. Patent 1604021. W. T. Chamberlain, 56 W. 91st St., New York, N. Y.

HEATER.—Which includes an inner stove, and an outer ornamental casing which may be opened to expose the fire glow, without the unsightly parts. Patent 1604869. W. F. Allen, c/o Allen Mfg. Co., Nashville, Tenn.

Machines and Mechanical Devices

PLEATING-PATTERN-MAKING MACHINE.—For producing a pattern containing combinations such as box plaits, side plaits, accordion plaits, knife plaits, etc., either in succession, alternation or otherwise. Patent 1602272. A. Korger, c/o G. J. Losey, 17 Union Savings Bank Bldg., Eau Claire, Wis.

DISPENSING DEVICE.—For containing a multiplicity of numbered balls which are discharged one at a time, the idea being to discharge the balls at random. Patent 1602358. I. M. Getskay, 225 W. 86th St., New York, N. Y.

AERIAL TRAMWAY.—In which is provided track means and an assemblage on the "angle station" whereby the haul rope is constrained to follow a path corresponding with the path of travel of the haul link.

Patent 1602271. G. M. Kilcarr, c/o Interstate Equipment Corp., 25 Church St., New York, N. Y.

GUIDE BEARING.—An adjustable fluid tight guide bearing especially designed for use in connection with the lower end of a water wheel. Patent 1602288. A. S. J. Stovall, Elberton, Ga.

APPARATUS FOR UPSETTING SCREEN WIRE.—For crimping a regularly spaced apart woven wire screen, so as to leave flat portions and sharp angles between the flat portions. Patent 1602049. M. J. Somers, 592 So. Fountain Ave., Springfield, Ohio.

LUBRICATOR FOR CHAINS.—Which affords facilities for feeding a lubricant onto the links of a chain moving within a case, so that the same oil may be repeatedly used. Patent 1601780. W. W. Tripp, c/o D. F. Burns, Durham Hosiery Mills, Durham, N. C.

OIL GAUGE FOR TANKS.—Wherein the indicating mechanism may be arranged at any desired point, while the actuating structure is positioned in the oil receptacle. Patent 1603162. R. Star, 84 Flushing Ave., Brooklyn, N. Y.

METHOD OF AND APPARATUS FOR TREATING COFFEE.—By sweating and roasting the coffee, and moistening and cooling the same, to remove any rawness and mellow the flavor. Patent 1603189. W. H. Bruning, 100 Upper 1st St., Evansville, Ind.

METHOD OF AND APPARATUS FOR LAYING SUBMERGED PIPE LINE.—Which will eliminate the necessity for the service of divers, and the expense of joining the sections under water. Patent 1603106. J. V. Ferry and A. P. Miller, c/o James Ferry, Inc., Atlantic City, N. J.

STRIPPER GUIDE.—Used in rewinding silk, wherein the cleaning plate is so arranged that it will not accidentally move out of its support. Patent 1603186. F. Bianchi, c/o Schwarzenbach Co., Union City, N. J.

METHOD OF PRODUCING PISTON RINGS.—So that when placed in a cylinder bore the ring will expand with equal pressure against the cylinder wall at all points. Patent 1603149. W. R. Reese, 749 N. Maire Ave., Scranton, Pa.

PICTURE-PROJECTION APPARATUS.—Which is combined with a race track, to stimulate the racing instincts of racing animals, such as greyhounds and whippets. Patent 1602,499. P. W. Meinecke, 10752 106th St., Richmond Hill, L. I., N. Y.

SELF-LOADING CAR.—Of such character that they are especially adapted for use in mines, such as coal mines, or in metal mining operations. Patent 1602779. W. Prockter, Box 1277, Huntington, W. Va.

CYLINDER PROTECTOR.—For preventing the accumulation of fallen rust, scale, sticks, etc., from interfering with the working barrel of a well. Patent 1602773. A. B. Mueller, Runge, Texas.

INK DRIER FOR PRINTING PRESS.—Consisting principally of a conveyor and a stacking device, and means for heating printed sheets while they are passing on the conveyer. Patent 1602157. W. A. Hornbeck, Red Bluff, Calif.

TUBE AND PIPE TESTING MACHINE.—In which the retention of the tube between the holders, is accomplished by the utilization of the fluid pressure which is admitted to the tube. Patent 1604012. J. C. Bareiss, 1735 Ingersoll St., Philadelphia, Pa.

COLOR PRESS.—Whereby two or more colors are printed simultaneously, resulting in a saving of time, and giving perfect registry of the different colors. Patent 1604046. A. Heiner, 447 E. 80th St., New York, N. Y.

VENDING MACHINE.—Particularly adapted for the vending of the cores of tire valves, and effecting the delivery of a single core. Patent 1602765. H. S. Green and J. L. Magner, Stewart Hotel, San Bernardino, Calif.

MACHINE FOR MEASURING THE SPECIFIC GRAVITY OF A LIQUID.—Automatically recording the specific gravity, and indicating the same in terms of the ratio of its density to that of pure water. Patent 1604387. F. E. Caldwell, 312 Ellis Ave., Wynnewood, Okla.

FAN.—A rotary fan or blower, the blades of which function to deflect, compress and discharge air in a continuous stream. Patent 1604877. J. A. Burckhalter, 915 Ogden Ave., New York, N. Y.

SEWING MACHINE.—Which provides for materially increasing thread supply, tending toward an elimination of the frequent necessity for bobbin filling. Patent 1604422. E. Poitevin and F. Ruiseco, c/o E. L. Cresho, 492 Second St., Brooklyn, N. Y.

CONCENTRATOR.—Which will handle a great amount of placer gravel with a minimum amount of water, the material passing over the same moving in zig-zag form. Patent 1603695. A. D. Hinton, 1300 Alcatraze Ave., Berkeley, Calif.

PUMPING JACK.—Which imparts a true rectilinear movement to the polish rod thereby relieving the rod, and parts of the jack from strain and preventing wear. Patent 1605437. V. L. Hudson, c/o G. C. Spillers, Attorney, Tulsa, Okla.

TUB BRACKET.—For use on washing machines, well adapted to provide a firm structure which may be folded when not in use. Patent 1605510. E. M. Carskadon, Richwood, W. Va.

PROPELLER.—For water and air craft, having relatively light blades in which streams of water are thrown rearwardly by centrifugal action. Patent 1604994. P. P. Grosso and H. A. Newkirk, c/o Dr. P. P. Grosso, U. S. Marine Hospital No. 5, 4141 Clarendon Ave., Chicago, Ill.

INJECTOR JET FOR GAS WELLS.—By means of which water which accumulates in the well may be forced out automatically by the pressure of the gas itself. Patent 1605174. M. E. Craig and W. H. Fordyce, c/o M. E. Craig, Box 45, Eram, Okla.

Medical and Surgical Devices

SURGICAL INSTRUMENT.—By means of which enemas may be given in a sitting position, and without the patient assuming a reclining position. Patent 1602750. W. F. Cole, 1003 Amicable Bldg., Waco, Texas.

DENTAL MIRROR.—Adapted to be manipulated quickly and easily to disclose a relatively great number of parts within the mouth of the patient. Patent 1604595. B. M. O'Brien, Sangerville, Maine.

Prime Movers and Their Accessories

AUTOMATIC HUMIDIFIER.—For humidifying air introduced into the carbureter or charge-forming device of the fuel system of internal combustion motors. Patent 1603,139. W. E. Morse, Rapid City, S. Dakota.

CHARGE FORMING DEVICE.—Whereby fuel may be sprayed upon a heated pan in a closed chamber subject to the suction of the engine, and the flow controlled. Patent 1603660. T. Cassella, c/o A. J. O'Brien, 114 Sansome St., San Francisco, Calif.

DEVICE FOR CLEANING THE COOLING SYSTEM OF AN INTERNAL-COMBUSTION ENGINE.—Which will cause a circulation of water, under pressure, through the radiator and cooling jacket, for expelling all rust or foreign matter. Patent 1605189. D. H. Hughes and H. D. Holcomb, Box 548, Warren, Ohio.

ANTIFREEZING MIXTURE.—Which may be used in internal combustion engines, forming a protective coating for the metal, the solution comprising castor-oil dissolved in alcohol, and calcium chloride. Patent 1605,377. G. A. Schultheiss, 1035 State St., Kansas City, Kans.

PRIME MOVER.—Constructed to eliminate the use of crank shafts and friction producing bearings, necessary in the usual reciprocating engines. Patent 1604474. P. Nisbet, 938 So. Plymouth Blvd., Los Angeles, Calif.

GENERATOR.—Which has no springs, moving parts, or small pipes to get out of order, and but one small cut off valve. Patent 1605182. W. H. Giltner, 198 No. Ashland Ave., Lexington, Ky.

VALVE.—A rotary valve particularly designed for the opening and closing of the intake and exhaust ports of an internal combustion engine. Patent 1605807. D. J. Cloyd, 325 Prospect Ave., El Paso, Texas.

Railways and Their Accessories

TIE PLATE AND RAIL CLIP.—Having the advantages of the ordinary tie plate, and which remains clamped to the rail even after the cross tie begins to decay. Patent 1602,458. W. F. Roberts, c/o So. Bell Tel. & Tel. Co., 117½ Gay St., Knoxville, Tenn.

TRAIN SYSTEM.—For underground or elevated railways in large cities, whereby the carrying capacity of the trains may be increased without increasing platform space. Patent 1604932. R. H. Rippere, 1819 Newkirk Ave., Brooklyn, N. Y.

LOCOMOTIVE DRAFT DEVICE.—For uniformly distributing a draft of air to the fire bed and for introducing a current of preheated air into the combustion space. Patent 1601350. J. J. Deegan, Box 1261, Sacramento, Calif.

RAIL FASTENER.—Consisting of a removable tie plate secured to its support by spikes, yet may be locked to prevent accidental removal. Patent 1605129. G. K. Meade, c/o Robert E. Crerar, Box 395, Kimberley, B. C., Canda.

Pertaining to Recreation

FIGURE WHEELED TOY.—Adapted to cause rolling movement to a hoop, and to actuate a miniature mechanical figure supported within the hoop. Patent 1602295. O. D. Willis, 633 14th St., Huntington, W. Va.

AMUSEMENT DEVICE.—In the nature of a roller coaster, drawn by an electric motor car, but dispensing with a third rail, or other conditions dangerous to passengers. Patent 1603254. W. F. Mangels, 2875 W. 8th St., Coney Island, N. Y.

TOY FERRY BOAT.—Upon which numerous small toy vehicles can be carried, the toy having casters so that it may be rolled about the floor. Patent 1602789. W. A. Thompson, Box 57, Port Gamble, Wash.

GAME APPARATUS.—Which will enable the operator to play the game of tenpins, or bowling, the apparatus may be large, for park use, or small and portable. Patent 1604047. L. Hinz, 39 Brookwood Ave., East Orange, N. J.

CUSHIONING ATTACHMENT FOR PUNCHING MACHINES.—In the form of a platform or buffer element, for absorbing the shocks usually caused by the striking of a punching bag. Patent 1603610. J. C. Korth, 1139 Tiffany St., New York, N. Y.

GAME DEVICE.—Of an educational nature, in which will incidentally arise the problems in accordance with the rudiments of arithmetic. Patent 1604846. G. A. Nelson, 46 W. 46th St., Bayonne, N. J.

CROSS-WORD-PUZZLE DEVICE.—Of a character to indicate to a child the letter to be placed in a given square of the puzzle, thereby possessing educational value. Patent 1605825. F. Fekete, 210 So. 21st St., Flushing, N. Y.

Pertaining to Vehicles

TIRE LOCK.—Adapted to be applied to the valve stem of a tire mounted upon an automobile wheel, for preventing the unauthorized removal of the tire. Patent 1601,816. B. Fierro, Box 575, Fort Bliss, Texas.

THREE-WHEEL-VEHICLE CHASSIS.—Particularly adapted for use for light delivery motor vehicles, due to the fact that it may be turned about in a relatively small space. Patent 1602042. E. L. Pearson, 910 Fletcher St., Chicago, Ill.

AUTOMATIC BRAKING DEVICE.—Which may be applied in less time than ordinary friction brakes, and will automatically come into action when the engine is stalled. Patent 1602171. C. L. Rockwell, c/o Y. M. C. A., Alton, Ill.

HEADLIGHT.—Having a form of reflector and lens which will give full road illumination but will prevent glare. Patent 1603,253. O. J. Appel, 82 Preakness Ave., Paterson, N. J.

LAUNDRY TRUCK.—Mounted on wheels, and provided with means whereby laundry from a laundry bag may be easily deposited into the truck. Patent 1603151. L. Rothbard, 74 Rutgers Slip, New York, N. Y.

SAFETY REAR-AXLE BRACE.—Which serves to hold the rear axle in its normally alined position, even in the event of the breaking of one of the rear springs. Patent 1602,466. W. J. Swett, c/o F. A. Krieger, Yellowstone Valley & Land Irrigation Co., Livingston, Mont.

HEADLIGHT MOUNTING.—In which the lights will tilt downwardly on striking an obstruction, thus prevent the glare being thrown upward into the face of an approaching driver. Patent 1603252. O. J. Appel, 82 Preakness Ave., Paterson, N. J.

HUB AND AXLE ASSEMBLY.—Mounted to rotate on the axle with but relatively little friction, automatically adjustable to compensate for wear on the moving parts. Patent 1602472. W. Woolgar, Sr. R. 6, Saginaw, Mich.

VEHICLE SPRING.—Adapted to effectively check rebound of the body supported, without causing any undue strain on the springs, may be incorporated with various automobiles. Patent 1603702. E. Matthews, 511 Colfax Ave., W., Denver, Colo.

VEHICLE BRAKE.—Of the type in which brake disks are employed, adapted to have frictional braking engagement, with a slight expenditure of force. Patent 1604060. J. Matthews, Absecon, N. J.

DIRIGIBLE HEADLIGHT FOR VEHICLES.—In which the headlights themselves house the means for swinging with the wheels, and for tilting forwardly when the headlights are swung. Patent 1603315. J. M. Calkins, Box 611, Detroit, Mich.

TIRE RACK AND CHANGER.—Operable to decrease the effective diameter of the rim so that a tire can be removed therefrom or placed thereon quickly. Patent 1604879. G. Champoux, Salmon Falls, N. H.

TIRE-VULCANIZING APPARATUS.—For tires of motor vehicles, the tires during the vulcanizing process remaining out of contact with the heating medium. Patent 1604579. A. L. Jacobson, Olive Hotel, Franklin and Washington Sts., Tampa, Fla.

TOOL FOR DRIVING WOODEN AUTOMOBILE WHEELS ON AXLES.—The same tool may be used for forcing various types of wheels on the axles, and is adapted to uniformly contact with the entire hub. Patent 1604479. A. J. Pauly, 1240 Orange St., Beaumont, Texas.

CONTROL FOR GEAR-SHIFTING MECHANISM.—By which gears cannot be meshed by the movement of the shift lever, until their linear speeds are substantially equal. Patent 1604856. D. P. Smith, 90 Bayard Lane, Princeton, N. J.

SPRING LIFTER.—So constructed that the work of compressing the spring in advance of removing the valve for the purpose of grinding, can be carried on conveniently. Patent 1600965. W. T. Bickmore, 310 Rodriguez St., Watsonville, Calif.

AUTOMATIC BRAKE.—Especially adapted for use on automobiles, also designed for use as a lock to prevent unauthorized persons from operating the car. Patent 1605340. C. H. Gallagher and J. P. McGlynn, 2 Lee Bldg., 15 So. Franklin St., Wilkes-Barre, Pa.

ASSEMBLING TOOL FOR AUTOMOBILE SPRINGS.—For assembling and removing spring hangers of Ford automobiles, the tool is quickly applied, of simple construction, and with only one moving part. Patent 1605771. P. Pringle, 232 W. Albany St., Herkimer, N. Y.

AUTOMOBILE LOCK.—Adapted to be associated with the steering column and dash board, whereby the engine cannot be operated by an unauthorized person. Patent 1605762. A. Norberg and L. B. Lodmell, Bowbells, N. D.

TRACTOR HITCH.—Adapted for use with coupling connections of various agricultural implements, actuated automatically to release the load when undue stress is placed upon the hitch. Patent 1606728. O. B. Skonnord, Valley City, N. D.

WINDOWS FOR AUTOMOBILES.—Capable of movement, to permit the occupants to arrange the windows to suit various conditions, the rear portion of the car being readily converted to form in effect a limousine or sedan. Patent 1606675. G. Tasman, c/o Locke & Co., 453 E. 56th St., New York, N. Y.

Designs

DESIGN FOR A MONUMENT.—The inventor has been granted three patents for ornamental designs of a similar nature. Patents 71458, 59, and 60. L. E. Hill, c/o Cross Bros. Co., Northfield, Vermont.

DESIGN FOR A BELT.—Patent 71283. I. Leibovitz, 105 Wooster St., New York, N. Y.

DESIGN FOR A BADGE OR SIMILAR ARTICLE.—Patent 71285. F. Lewis and O. Friedman, 824 Bedford Ave., Brooklyn, N. Y.

DESIGN FOR A NECKTIE RACK.—Patent 71335. Fanny C. Morse, 1 West 67th St., New York, N. Y.

DESIGN FOR A RADIO LOUD-SPEAKER FRAME.—Patent 71355. H. B. Bergere, 1004 Union St., Brooklyn, N. Y.

DESIGN FOR A BOX.—Patent 71406. F. A. Purchas, c/o McGraw Box Co., McGraw, N. Y.

DESIGNS FOR DRESSES AND SUITS.—Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y., have been granted eight patents relating to dresses and suits, having characteristic designs produced by their designer, T. Davis. Patents Nos. 71359, 71360, 61, 62, 63, 64, 65, 66.

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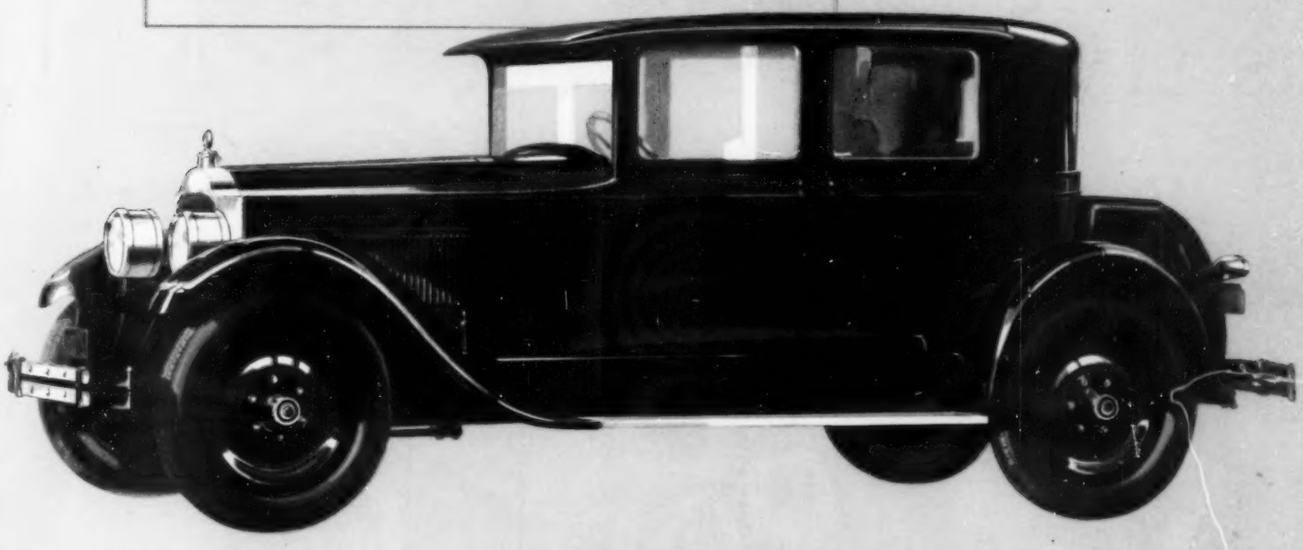

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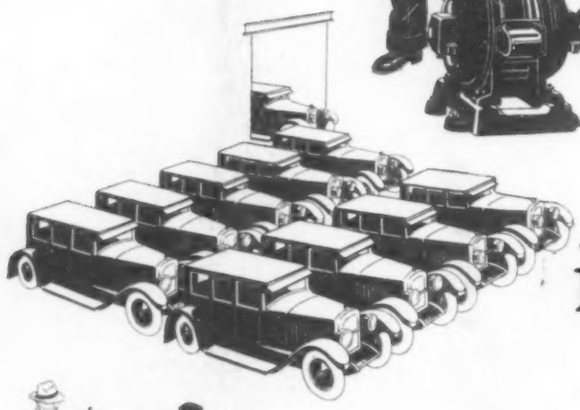

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